Maryland Innovation and Technology Index 2001

Forward

Produced by the Maryland Technology
Development Corporation

Maryland TEDCO
Technology Development Corporation

www.marylandtedco.org

The gateway to Maryland's technology community.

5575 Sterrett Place, Suite 240 / Columbia, MD 21044
P: 410-740-9442 / F: 410-740-9422

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Dear Reader:

The Maryland Technology Development Corporation (TEDCO) is pleased to present the *Maryland Innovation and Technology Index 2001*. The *Index* provides a strategic assessment of the condition of Maryland's technology assets and the degree to which they are reflected in economic performance. It is provided for benchmarking by state policymakers and advocates who are interested in understanding, promoting and enhancing the State's competitive position. The *Index* looks at Maryland's competitiveness at each point along the continuum of innovation in terms of performance, dynamics and resources and builds on the *1999 Index* of the same name. Maryland is compared to five other states: Massachusetts, New Jersey, North Carolina, Pennsylvania and Virginia, chosen because they are either our most important neighbors or acknowledged East Coast technology leaders.

The *2001 Index* reveals that Maryland continues to be a national leader in R&D resources, but lags in capitalizing on these assets for economic impact. It is hoped that this data will provide a benchmark to evaluate strengths and weaknesses and enable the State to improve its position.

TEDCO was created in 1998 as a public instrumentality of the State of Maryland, with the purpose of fostering the commercialization of research and development to create and sustain businesses throughout all regions of the State. TEDCO is governed by a 15 member Board of Directors comprised of technology leaders from the private, university, non-profit and public sectors. The Board has adopted as its vision statement that Maryland will become internationally recognized as one of the nation's premier 21st century locations for technology and technology based economic development. To achieve this goal, in its first year of operations, TEDCO has developed programs that link emerging companies with federal laboratories, further university R&D, and support business incubation.

Phillip A. Singerman

Phillip A. Singerman, Ph.D.
Executive Director
Maryland Technology
Development Corporation

TABLE OF CONTENTS

MAGNIFYING AND REDUCING PAGE VIEW

Throughout this document, it may be necessary for you to view charts and data in greater detail than how they are first presented. This is accomplished by using the magnification and hand tools located above, in the menu bar.

To increase magnification:
Select the zoom-in tool and click on an area of interest.

To decrease magnification:
With the zoom-in tool selected, press Ctrl (Windows and UNIX) or Option (Mac OS) while clicking to zoom out instead of in.

If you magnify a page to a size larger than the window, use the hand tool to move the page around so that you can view all the areas on it. Moving a PDF page with the hand tool is like moving a piece of paper on a desk with your hand.

Maryland Innovation and Technology Index 2001

The *Maryland Innovation and Technology Index 2001* provides a strategic assessment of the condition of Maryland's technology assets and the degree to which they are being reflected in economic performance. Used alongside the *1999 Index*, it is provided for benchmarking use by state policymakers and advocates who are interested in understanding, promoting, and enhancing the state's competitive position. In order to facilitate comparisons to the previous report, a summary of rankings, change in rankings, and change in indicators has been included in the *2001 Index*.

Why measure it?

We know that half the economic growth of the United States over the past 50 years has been attributable to technical progress, equal to the contribution of labor and capital combined. Good-quality jobs for Marylanders in the 21st century will be produced by the creation and growth of technology-based companies, and by the increased competitiveness of other Maryland companies realized through the adoption of new technology.

The report's three sections look at Maryland's competitiveness at each point along the continuum of innovation:

PERFORMANCE—Measures of the economic impact of the successful introduction of scientifically based innovations into the marketplace.

DYNAMICS—Measures of processes that add management talent, financing and know-how to transform discovery into products and services with commercial potential.

RESOURCES—Measures of the human, intellectual, financial and physical capital that provides the infrastructure for innovation.

How is Maryland doing?

The report paints a picture of opportunities being missed. Compared to 1999, Maryland is at best holding its own among the competitor states, or worse, losing ground. Maryland's growth in technology employment and output, venture capital, initial public offerings, new company formation, university technology commercialization, and research and development has not exceeded growth elsewhere, and in many cases has lagged behind.

Maryland's technology sectors, particularly in services, continue to lead the state's economic resurgence and contribute disproportionately to the high quality of life enjoyed by its citizens. Much of the state's extraordinary discovery resources and commercial technology success is attributable to the federal government's strong presence in the state. The federal government not only conducts or underwrites the lion's share of research and development in Maryland, it also buys a large share of the technology goods and services produced by Maryland companies. And yet, some competitor states with more modest technology endowments have achieved better economic performance.

The under-exploited resources highlighted in this *Index* call for strategic investments that will achieve excellence in science and mathematics from kindergarten through graduate school, commercialize discoveries at universities and federal laboratories, and grow the state's numerous technology-based start-up companies to maturity. Incentives to encourage industry research and development should also be considered.

Marsha R. B. Schachtel, Senior Fellow at the Johns Hopkins Institute for Policy Studies (IPS), prepared the report, assisted by Douglas Sahmel and Corey Stottlemyer, graduate students in the IPS Masters in Policy Studies program. The report was produced by MGH Advertising, Inc.

Competitor State Thumbnail Sketches

In most cases, the *Index* normalizes data to account for size differences among the states using population, number of business establishments, or employment base, depending on which is most appropriate. In order to make such comparisons more meaningful, a brief summary of vital demographic and economic statistics for each of the states is provided below:

Measure	MD	MA	NJ	NC	PA	VA
Population (1)	5.17	6.18	8.14	7.65	11.99	6.87
Population change (2)	.8	.5	.6	1.4	-.1	1.2
Net int'l migration (3)	17.2	14.9	39.7	8.3	13.0	18.5
Establishments (4)	151.0	209.3	286.4	219.0	356.9	182.1
Employment (5)	2.46	3.31	3.94	3.92	5.60	3.51
Employment change (6)	2.3%	1.8%	1.4%	.8%	.3%	2.1%
Unemployment rate (7)	3.6%	2.6%	4.0%	3.8%	4.2%	2.1%
% Mfg	7.1	13.1	11.5	19.6	16.5	11.2
% Trade	23.0	22.6	23.5	22.3	22.4	21.5
% FIRE (8)	5.7	7.0	6.6	4.9	5.8	5.4
% Services	34.7	36.4	33.1	26.6	32.4	32.5
% Govt	18.3	12.8	14.8	16.1	12.8	17.9

(1) 1999 number of persons in millions (U.S. Census Bureau)
(2) 1998-1999 (U.S. Census Bureau)
(3) 1998-1999 in thousands (U.S. Census Bureau)
(4) 1998 in thousands Cognetics, Inc., using Dun and Bradstreet Data
(5) November 2000 number of jobs in millions, seasonally adjusted, U.S. Bureau of Labor Statistics (also date and source of economic structure percentages)
(6) November 1999-November 2000, 12-month percentage change in total employment
(7) November 2000, seasonally adjusted
(8) Finance, insurance and real estate

Summary

The following summary of the full *Index 2001* captures Maryland's competitive ranking on all indicators, the direction of change in ranking (if any) since the 1999 *Index*, and the direction of change in the actual indicator in the most recent period measured.

Indicator	Competitor State Rankings (#1 is best) 1	2	3	4	5	6	MD change in rank from previous period	MD change in metric from previous period
Performance								
Private high-tech employment growth	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	∧
Technology-intensive industry employment:								
*SIC 28 chemicals employment	NJ	PA	NC	VA	MA	MD	none	∧
*SIC 35 non-electric machinery & computers	PA	NC	MA	NJ	VA	MD	none	∧
*SIC 36 electrical and electronic equipment	PA	MA	NC	NJ	VA	MD	none	∧
*SIC 37 transportation equipment	PA	VA	NC	VA	MD & NJ		none	∨
*SIC 38 instruments	MA	PA	NJ	MD	VA		none	∨
*SIC 48 communications services	NJ	PA	VA	MA	MD		none	∧
*SIC 73 business services	NJ	PA	VA	MA	MD		none	∧
Percent of employment that is in tech industry	MA	VA	MD	NJ	NC		new	new
Output of technology-intensive manufactures	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	∧

Indicator	Competitor State Rankings (#1 is best) 1	2	3	4	5	6	MD change in rank from previous period	MD change in metric from previous period
Performance								
Output of technology-services industries:								
*Computer services	VA	MA	NJ	PA	MD	NC	v	∧
*Engineering services	PA	VA	MD & MA		NJ	NC	none	∧
Gazelles as a percentage of total firms	MA	NJ	MD	PA	VA	NC	new	new
Baby gazelles total index	MD	NC	VA	MA	NJ	PA	none	none
Net tech firm births / 10,000 establishments	MA	NJ	VA	MD	NC	PA	new	new
Percent of start-ups that are in tech industry	MA	NJ	VA	MD	PA	NC	new	new
Number of initial public offerings	MA	PA	MD	NJ	VA	NC	v	none
Proceeds of initial public offerings	MA	MD	VA	PA	NJ	NC	v	v
Average weekly wages	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	∧
Personal income per capita	MA & NJ		MD	VA	PA	NC	none	∧

Summary
Performance
Dynamics
Resources
Appendix

Indicator	Competitor State Rankings (#1 is best) 1	2	3	4	5	6	MD change in rank from previous period	MD change in metric from previous period
Dynamics								
Patents to state residents / 100,000 population	NJ	PA	MA	NC	MD	PA	none	∧
University invention disclosures	PA	MA	MD	NC	VA	NJ	none	∧
University new patent applications filed	PA	MA	MD	NC	VA	NJ	none	∧
Patents issued to universities	MA	PA	MD	NC	VA	NJ	∧	∧
University licenses executed	NC	MA	MD	PA	VA	NJ	none	∧
University license income received	MA	NC	PA	MD	VA	NJ	none	∧
Start-ups based on university technology	MA	PA	MD & VA		NC	NJ	none	∧
Industry-financed R&D at universities	PA	NC	MA	VA	MD	NJ	∨	∧
STTR awards	MA	VA	MD & NJ		PA	NC	none	∨
STTR value of awards	MA	VA	NJ	MD	NC	PA	∨	∨
Fed'l procurement of tech goods & services	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	none
SBIR awards	MA	VA	MD	PA	NJ	NC	none	∨
SBIR value of awards	MA	VA	MD	PA	NJ	NC	none	∧
Venture capital investments	MA	NC	MD	VA	NJ	PA	∧	∧
ATP awards	MA	NJ & VA		MD & NC & PA			none	none

<table>
<tr><th>Indicator</th><th colspan="6">Competitor State Rankings (#1 is best)</th><th>MD change in rank from previous period</th><th>MD change in metric from previous period</th></tr>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th></th><th></th></tr>
<tr><td colspan="9">Dynamics</td></tr>
<tr><td>Capital inv't in technology-intensive mfg / emp</td><td>VA</td><td>PA</td><td>MA</td><td>NJ</td><td>MD</td><td>NC</td><td>none</td><td>∧</td></tr>
<tr><td>Technology manufacturing productivity</td><td>n.a.</td><td>n.a.</td><td>n.a.</td><td>n.a.</td><td>n.a.</td><td>n.a.</td><td>n.a.</td><td>∧</td></tr>
<tr><td>Technology services productivity:</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>*Computer services</td><td>VA</td><td colspan="2">MA & PA</td><td>NJ</td><td>NC</td><td>MD</td><td>∨</td><td>∧</td></tr>
<tr><td>*Engineering services</td><td>MA</td><td>NJ</td><td>MD</td><td>PA</td><td colspan="2">NC & VA</td><td>∧</td><td>∧</td></tr>
</table>

Indicator	Competitor State Rankings (#1 is best) 1	2	3	4	5	6	MD change in rank from previous period	MD change in metric from previous period
Resources								
New companies / 1000 workers	MD	NC	NJ	VA	MA	PA	none	∨
% of companies <5 years old	NJ	MD	VA	NC	MA	PA	new	new
Patent attorneys / 10,000 business establishments	VA	MA	NJ	MD	PA	NC	new	new
R&D / GSP and R&D per capita	MA	MD	NJ	PA	VA	NC	none	∧
Federally funded R&D	MD	MA	VA	PA	NC	NJ	none	∧
Federally performed R&D	MD	VA	NJ	MA	NC	PA	none	∧
University-performed R&D	MA & PA		MD	NC	VA	NJ	∨	∧
Industry-performed R&D	MA	NJ	PA	NC	VA	MD	none	∧
Share of total U.S. R&D obligations	MD	VA	MA	PA	NJ	NC	none	∨
Federal R&D dollars per capita	MD	MA	VA	NC	NJ	PA	new	new
Percent holding Bachelor's degrees or above	MD	VA	MA & NJ		NC & PA		∧	∧
Recent S&E Ph.Ds in the workforce	MA	MD	NJ	PA	NC	VA	new	new
Recent Masters in the workforce	MA	MD	VA	NJ	NC	PA	new	new
S&E graduate students	MA	PA	VA	NJ	NC	MD	none	∨
S&E graduate students / 18-24-year-olds	MA	MD	PA	VA	NJ	NC	new	new
African American S&E grad students / all S&E	NC	MD	VA	NJ	PA	MA	none	∧
SAT scores	MA	MD	NJ	VA	PA	NC	none	∧

Indicator	Competitor State Rankings (#1 is best) 1	2	3	4	5	6	MD change in rank from previous period	MD change in metric from previous period
Resources								
Employment in technology occupations / 1000 emp:								
*Computer engineers	MA	VA	MD	NJ	NC	PA	none	∧
*Biological scientists	MD	MA	NJ	VA	NC	PA	none	∨
*Computer programmers	VA	MD	NJ	MA	NC	PA	n.a.	n.a.
Mean wages of technology workers:								
*Computer engineers	MA	NJ	NC	PA	MD	VA	∨	∧
*Biological scientists	NJ	MD	NC	VA	PA	MA	∧	∧
*Computer programmers	NJ	MA	MD	NC	PA	VA	n.a.	n.a.
Venture capital under management	MA	MD	NJ	PA	VA	NC	new	new
Telecomm infrastr: percent fiber	NJ	PA	MA	MD	VA	NC	none	∧
Telecomm infrstr: ISDN / access lines	MD	VA	NJ	MA	PA	NC	none	∧
Household computer ownership	NJ	VA	MD	MA	PA	NC	new	new
Household internet access	NJ	MA	VA	MD	PA	NC	new	new
Schools with internet access	MD & NC		VA	NJ	MA	PA	new	new
Teacher e-mail addresses	VA	NC	PA	MD	MA	NJ	new	new
Teacher technology skills	VA	MA	NC	MD	NJ	PA	new	new
Digital government	PA	MD	MA	VA	NJ	NC	new	new

PERFORMANCE

Measures of the economic impact of successful introduction of scientifically based innovations into the marketplace, including:

- Economic Structure and Growth
- Corporate Performance
- Corporate Finance
- Prosperity

Economic Structure and Growth

Indicator 1

High-technology employment is growing, especially in information technology.

Indicator 2

Growth in output of technology-intensive manufactured goods exceed national rates.

Indicator 3

Growth in exports of most technology-related goods has accelerated in the late 1990s.

Indicator 4

Growth in relatively small high-technology services output is modest.

Corporate Performance

Indicator 5

Maryland is home to over 6500 gazelle companies; it leads the competitor states in the launch and growth of "baby gazelles."

Indicator 6

Maryland ranks highly in net technology company births and share of start-ups that are in technology-intensive industries.

Corporate Finance

Indicator 7

Maryland competitiveness in IPOs is growing.

Prosperity

Indicator 8

Average wages in Maryland's technology industries continue to grow faster than the private sector as a whole.

Indicator 9

Maryland personal income is fifth-highest in the country and growing faster than the national average.

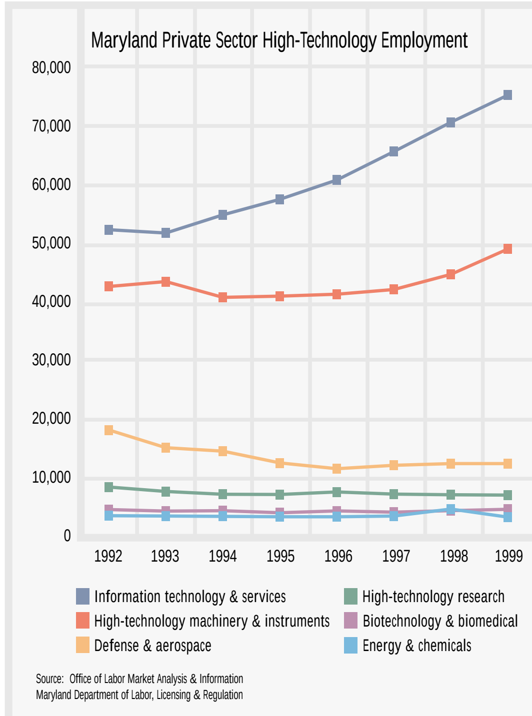
High-technology employment is growing, especially in information technology.

Why measure it?

States and communities value high-technology firms because they are innovators, which enables them to grow by gaining market share, creating new products and using resources more productively. The high value-added production and export success typical of these firms supports higher wages to employees, and the benefits of the research and development they perform spill over to other sectors of the economy.

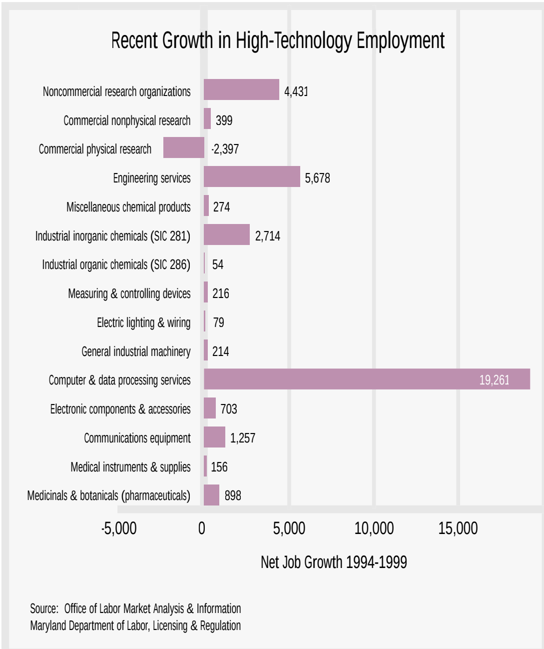
How is Maryland doing?

The U.S. Bureau of Labor Statistics (BLS) and the Office of Labor Market Analysis and Information of the Maryland Department of Labor, Licensing and Regulation classify as "high technology" those industries that spend significant percentages of their revenue on research and development, and that employ concentrations of workers with advanced skills. See Appendix Notes and Sources for definitions of industries included.



In 1999, the effects of the defense build-down were still felt in defense and aerospace employment remained below early-1990s highs. However, beginning in 1995 and 1996, the other segments of high-technology industry began to regain momentum, and in 1997, even the defense and aerospace sector began to stabilize. Led by information technology and services, which added over 20,000 jobs in the last five years, these other industries have expanded greatly in the last three years. High-technology employment grew 5.1 percent from 1998 to 1999, compared to 2.9 percent in Maryland's private sector as a whole. The annual rate of high-technology employment growth slowed, however; the 1997 to 1998 rate was 6.5 percent.

Within each of the broad technology categories, there were detailed industry categories that were doing better than others. Employment in computer and data-processing services grew 50 percent between1994



and 1999, adding 19,261 jobs (U.S. rate: 91 percent); engineering services, the second-largest detailed category, added 5,678 jobs for an increase of 30 percent (U.S. rate: 19 percent), and noncommercial research organizations grew by 4,431 jobs, an increase of 64 percent (U.S. rate: 8.2 percent). Among the smaller high-technology segments, pharmaceuticals grew more than twice as fast as the national average and medical instruments and supplies almost twice as fast. Communications equipment growth (24 percent) was three times the national average (7.8 percent), and electronic components also exceeded it (MD rate: 21.2 percent; U.S. rate: 16.9 percent). In all three high-technology equipment and instruments categories, growth in Maryland was at least twice the national rate, and all three chemicals categories showed positive growth in Maryland while declining nationwide.

At a higher level of aggregation (two-digit SIC), however, Maryland's technology-intensive employment growth was not impressive when compared to its most immediate neighbors and an acknowledged technology leader (Massachusetts). Only in electric and electronic machinery did its growth rate in 1999 lead the six states, and in most categories it ranked fourth.

Maryland ranked ninth among the most technology-intensive states in the country in 1996, the year for which the U.S. Department of Commerce asked the

Technology-Intensive Employment

% of total employment that is in technology-intensive SIC codes*

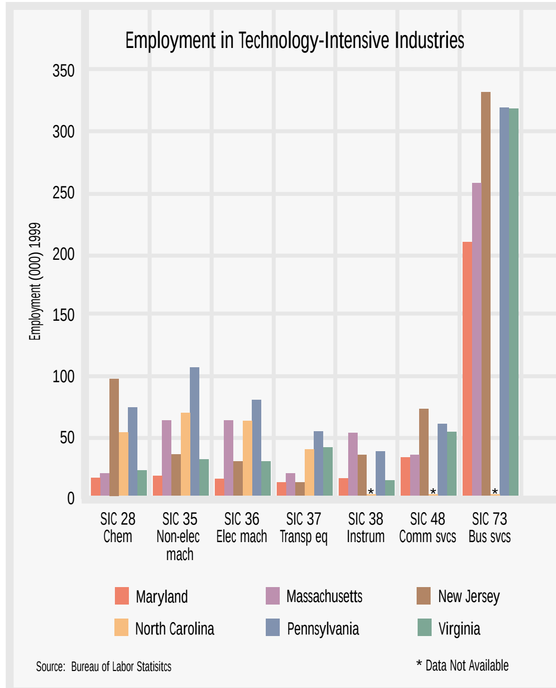
	%	Rank in U.S.
Maryland	9.3	9
Massachusetts	11.9	1
New Jersey	8.7	14
North Carolina	7.7	19
Pennsylvania	n.a.	n.a.
Virginia	10.7	2
U.S.	8.1	

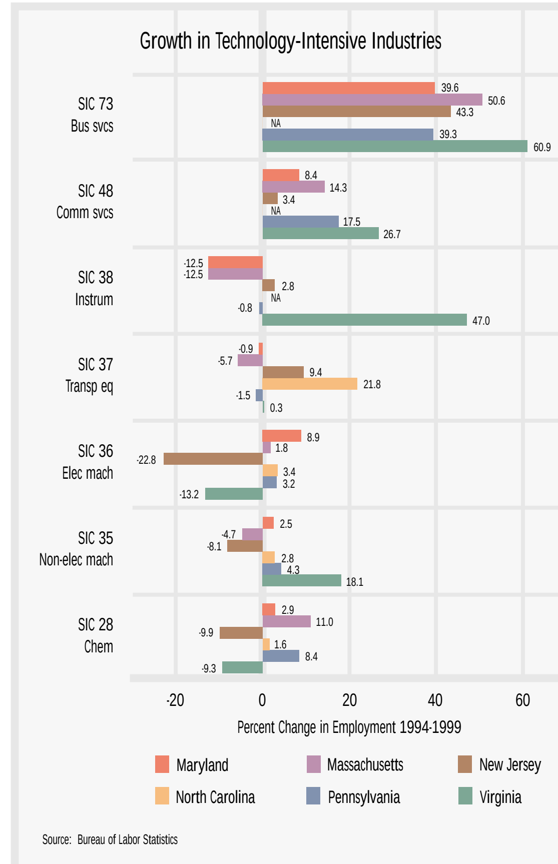
**Defined by Bureau of Labor Statistics, used by MD DLLR*

Source: U.S. Department of Commerce Technology Administration

Bureau of Labor Statistics (BLS) to make a special state-by-state analysis of employment in the industries which meet BLS's definition of high technology. Among the competitor states selected for this analysis were the top-ranked and number two states (Massachusetts and Virginia, respectively). Data for Pennsylvania is unavailable.

It should be noted that this data does not cover government employment. Beginning in 1997, the Maryland Department of Labor, Licensing and Regulation has added an estimate of high-technology employment in government to its annual high-technology update. If government employees were added, the total high-technology employment in 1998 would have been 183,345. The 36,736 government technology workers made up 20 percent of the total and increased 3.9 percent from the previous year.





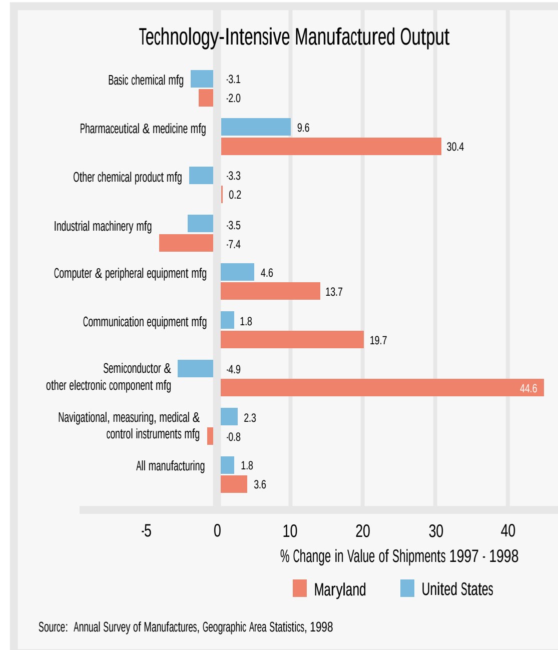
Growth in output of technology-intensive manufactured goods exceeds national rates.

Why measure it?

Because companies are continually seeking to achieve more output from existing resources, relying upon employment trends as the only measure of growth and decline in an industry may lead to inappropriate conclusions. Mature companies may shed jobs while still enjoying strong sales growth. A more complete picture emerges when changes in employment levels are examined alongside measures of industry output. Further insight may be gained by examining the degree to which capital is being substituted for labor (see Manufacturing Labor Productivity in RESOURCES section.)

How is Maryland doing?

Using the new North American Industrial Classification System (NAICS), technology-intensive manufactured output performance from 1997 to 1998 was better in Maryland than in the U.S. in every category except instruments. It should be noted that NAICS combines navigational, measuring, medical and control instruments in one category. Pharmaceutical shipments grew 30 percent, three times faster than the national average, a reflection of the growing maturity of Maryland's bioscience industry. Maryland communications equipment and electronic components shipments were growing much faster than employment, and were dramatically higher than national rates. Minimal growth or declines in chemical output in Maryland nevertheless outperformed the national average.



Growth in exports of most technology-related goods has accelerated in the late 1990s.

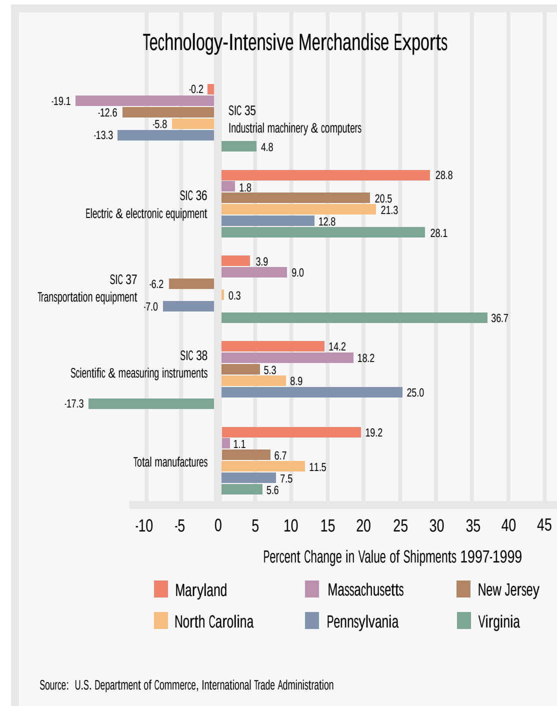
Why measure it?

The continuing vitality of the state's small manufacturing sector depends on its global competitiveness.

How is Maryland doing?

Maryland's relatively small manufacturing base is revealed in its technology-related merchandise export performance, which lagged far behind all the competitor states in 1999. While data is not available at fine levels of detail, 1999 merchandise exports in three of the four most technology-intensive broad manufacturing sectors in competitor states were two to nine times higher than Maryland's, even though only Pennsylvania had an economy over twice as large. In the fourth, scientific and measuring instruments exports, three other states were 38 to 500 percent higher. Massachusetts' instruments exports were nine times those of Maryland's. In 1999, Maryland instrument exports exceeded Virginia's for the first time.

In the late 1990s, however, Maryland technology merchandise exports have begun to grow more rapidly than many of the other competitor states. As was the case from 1993 to 1997, Maryland led these states in electric and electronic equipment export growth. Between 1997 and 1999, growth in exports of all Maryland-manufactured goods was higher than any of the competitor states, and 61 percent higher than the U.S. average.



Growth in relatively small high-technology services output is modest.

Why measure it?

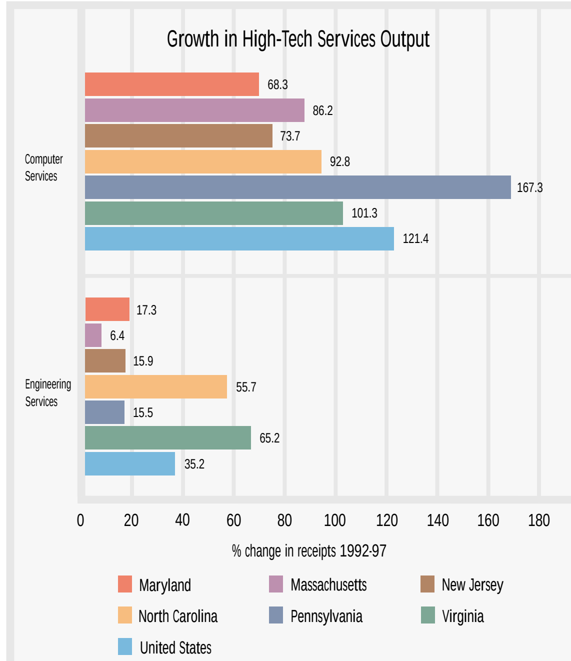
Services industries employ by far the majority of high-technology workers in Maryland, eighty percent in 1999. Technology services output, measured in receipts, also dwarfs technology-intensive manufactured goods shipments.

How is Maryland doing?

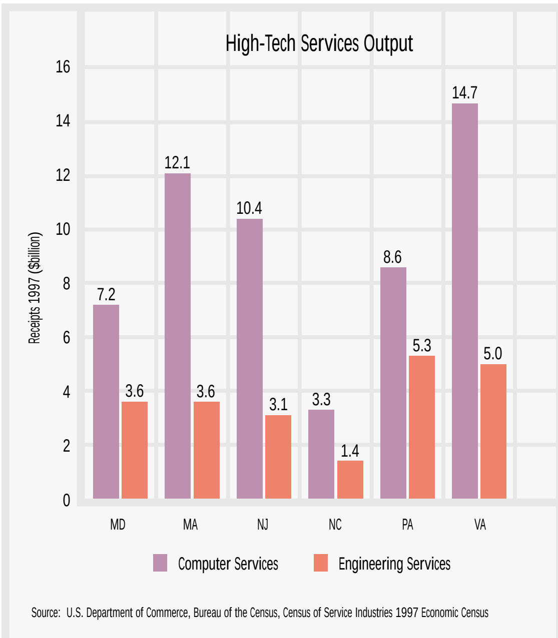
New economic census data only provides updates through 1997 and can be analyzed in detail only through the conversion of Standard Industrial Classification (SIC) categories to the new North American Industrial Classification System (NAICS), with sometimes imperfect results. However, several trends are apparent. In 1997, Maryland trailed all the competitor states except North Carolina in output of its computer services sector, which was not growing as fast as in other states. While engineering services output ranked in the middle of the competitor state group, it too was growing more slowly.

In addition to the two detailed industry sectors shown here, engineering services and computer services, a significant number of Marylanders are employed in commercial and non-commercial research and development. Under the new NAICS classification system, over 17,000 people worked in these industry sectors in Maryland in 1997, almost 40 percent of them in tax-exempt non-governmental organizations. Because of continuing disclosure issues in the data for the research and development sectors, it is not possible to gauge output growth.

1997 services export data will not be available until later in 2001.



Source: U.S. Department of Commerce, Bureau of the Census, Census of Service Industries, 1987, 1992, 1997 Economic Census


High-Tech Services Output
Receipts 1997 ($billion)
16
14
12
10
8
6
4
2
0
7.2
3.6
12.1
3.6
10.4
3.1
3.3
1.4
8.6
5.3
14.7
5.0
MD
MA
NJ
NC
PA
VA
Computer Services
Engineering Services
Source: U.S. Department of Commerce, Bureau of the Census, Census of Service Industries 1997 Economic Census

Maryland is home to over 6500 gazelle companies; it leads the competitor states in the launch and growth of "baby" gazelles

Why measure it?

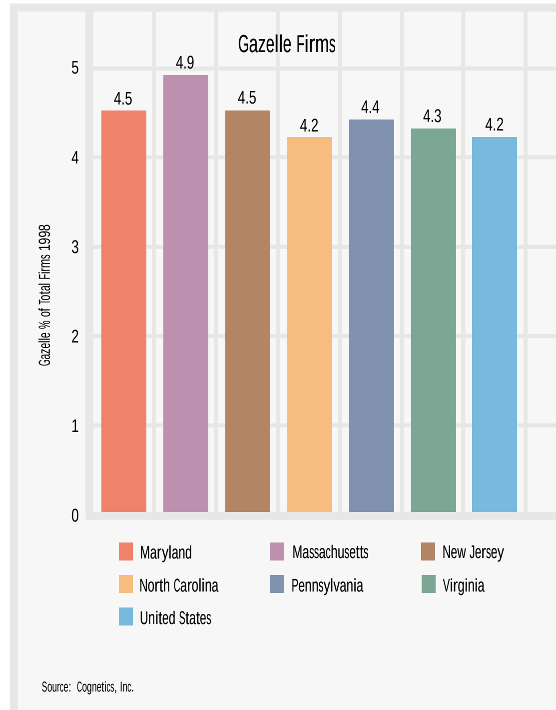
The degree to which start-up companies survive and grow significantly will shape a state's economic future. The next generation of growth companies is being incubated now. The frequency with which firms start and stay in business, or grow significantly, varies across states in patterns that do not necessarily parallel overall economic growth rates.

How is Maryland doing?

In 1998, Maryland ranked 18th in the number of firms that had revenue growth at a compound rate of 20 percent or more for the last four years (termed "gazelles" by David Birch). These firms accounted for 4.5 percent of all firms, ninth highest in the country. Maryland's gazelles were relatively small, however. Only 12.4 percent of all Maryland jobs in 1997 were in gazelle firms, ranking 43rd in the nation.

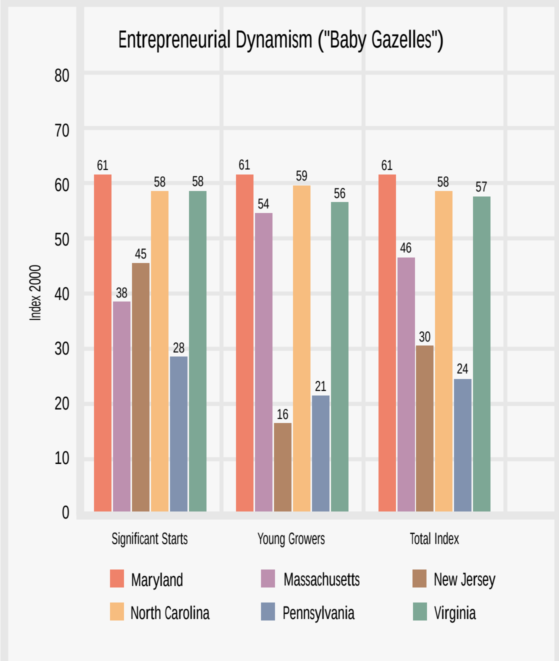
When evaluated by looking at the percentage of all firms accounted for by firms that have been started in the past ten years and still employ at least five people today ("significant starts"), and at the percentage of firms ten years old or less four years ago that grew significantly (a measure of absolute and percentage increase) during the last four years ("young growers"), Maryland ranked sixth in the nation in 2000, ahead of all the competitor states. The state rated equally well in significant starts and young growers, a noteworthy improvement over 1997, when its strong record in launching new companies was not matched by its success in growing them.

David Birch's Cognetics, Inc., which developed these indices, calls these companies "baby gazelles," and finds them not in low-cost locations but in places that feature universities, a skilled labor pool, airports and good quality of life. While the rankings are for all firms, not just technology companies, they provide a comparative look at the



relative attractiveness of places for starting and growing a business.

Inc. magazine annually publishes a list of 500 privately held companies ranked by revenue growth over the last five years. The companies nominate themselves for consideration. When the number of *Inc.* 500 companies is normalized using the number of business establishments in the state, Maryland ranked third behind Delaware (#1) and Massachusetts (#2). Virginia ranked fourth, New Jersey 12th, and North Carolina 20th in 1999. Delaware's ranking should be considered an anomaly because many companies with business activities elsewhere register in the state.



Source: Cognetics, Inc.

SUMMARY
PERFORMANCE
DYNAMICS
RESOURCES
APPENDIX

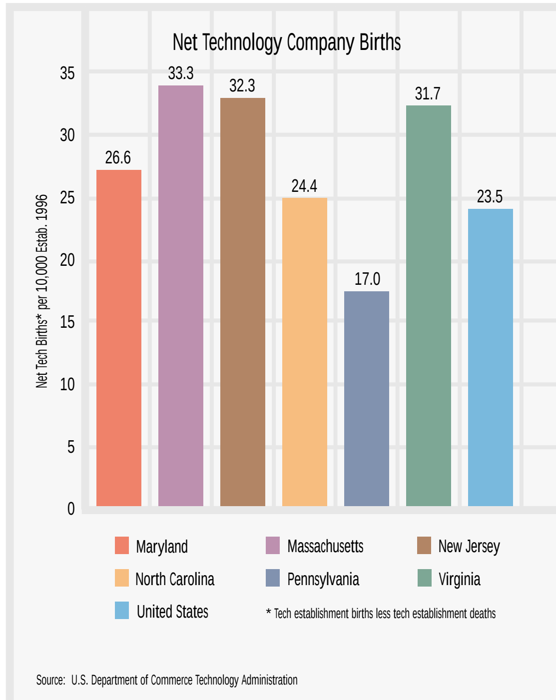
Maryland ranks highly in net technology company births and share of start-ups that are in technology-intensive industries.

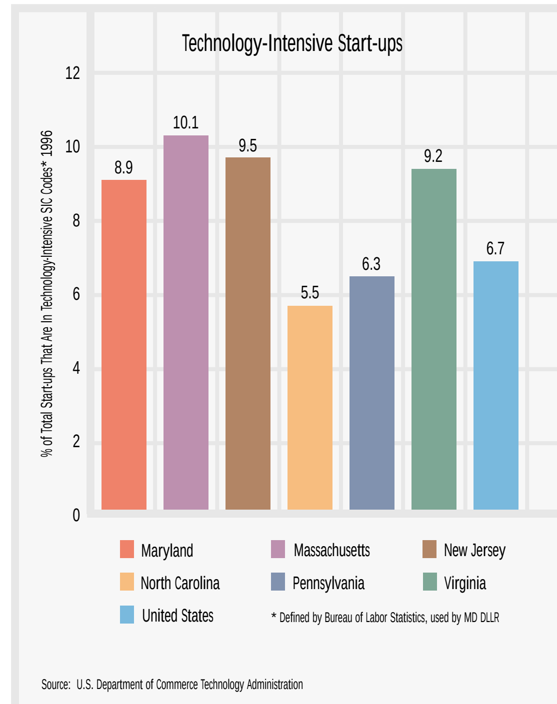
Why measure it?

While rates of new-company creation in all industries provide a barometer of the entrepreneurial climate in the state, they are often fueled by population growth. New data permits a comparison of technology-intensive entrepreneurship. These measures look at technology-intensive industries (as defined by the Bureau of Labor Statistics) only. A net calculation, which subtracts technology establishments that ceased operations within the year, permits comparison of states' environment for not only creating, but also sustaining technology businesses.

How is Maryland doing?

In a special analysis conducted by the Bureau of Labor Statistics for the U.S. Department of Commerce Technology Administration, technology establishment births and deaths were examined for 1996. Maryland ranked 13th in the U.S. and fourth among the





competitor states in net formations of technology-intensive establishments, normalized by the number of business establishments in the states. Maryland ranked seventh in the U.S. and fourth among the competitor states in the percentage of total establishment births that were in technology industries.

Maryland Competitiveness in IPOs is Growing.

Why measure it?

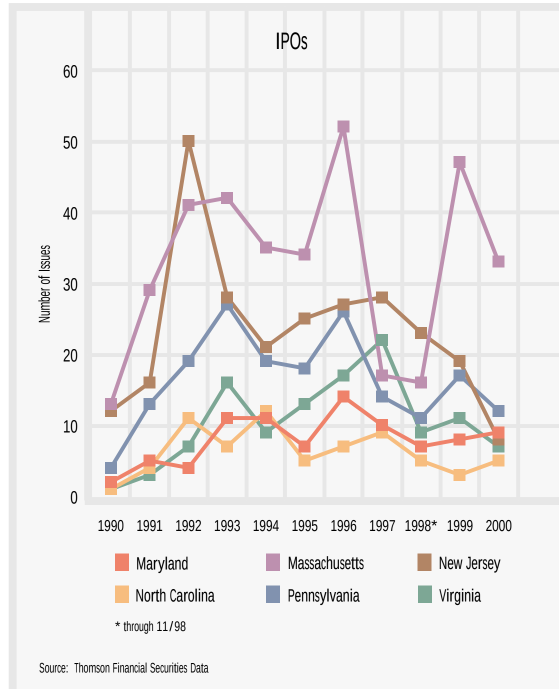
Initial public offerings (IPOs) are a measure of the flow of investor capital into companies judged to have high potential for commercial success and represent a milestone in broadening companies' access to capital. IPOs foretell the future base of high-growth companies. They reflect the entrepreneurial energy in the state and the level of venture capital investment.

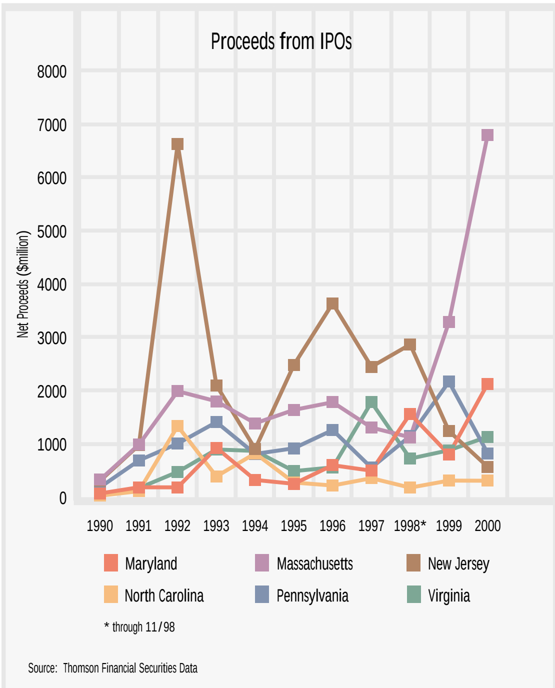
How is Maryland doing?

Maryland's IPO record, though uneven from year to year, continues to outperform expectations, given the relatively low rates of venture capital invested in Maryland companies. In number of IPO's, Maryland ranked third to Massachusetts and Pennsylvania in 2000, but second in proceeds, thanks once again to a large IPO by a telecommunications equipment firm. When normalized by business base size (IPO proceeds per business establishment) in 1999, Maryland ranked 14th, higher than all but Massachusetts (third) and Pennsylvania (tenth).

While Massachusetts has long dominated the number of IPOs, only in the past two years have its companies surpassed New Jersey's in the amount of capital attracted. Massachusetts' apparent loss of momentum in 1997 and 1998 has proven to be temporary. Maryland and North Carolina were the only two states to sidestep the lull in the market for IPOs in 2000, and only Massachusetts, Maryland and Virginia saw increases in IPO proceeds. In the past two years, Maryland's IPO totals have been growing, and after a brief downturn in 1999, proceeds have been increasing since 1997. Maryland ranked third (behind Pennsylvania and Virginia) in 2000 in proceeds per new issue.

In 1999, Aether Systems, AppNet, Digex (for the second time, being spun off by Intermedia Communications), Radio One, and Usinternetworking





led Maryland's initial public offerings. In 2000, when the NASDAQ market plummeted and almost as many companies announced withdrawals as offerings, Corvis set records with a $1.1 billion IPO, and was joined by E-centives, GenVec, InforMax, OTG Software, Sequoia Software, and TeleCommunication Systems.

Average wages in Maryland's technology industries continue to grow faster than the private sector as a whole.

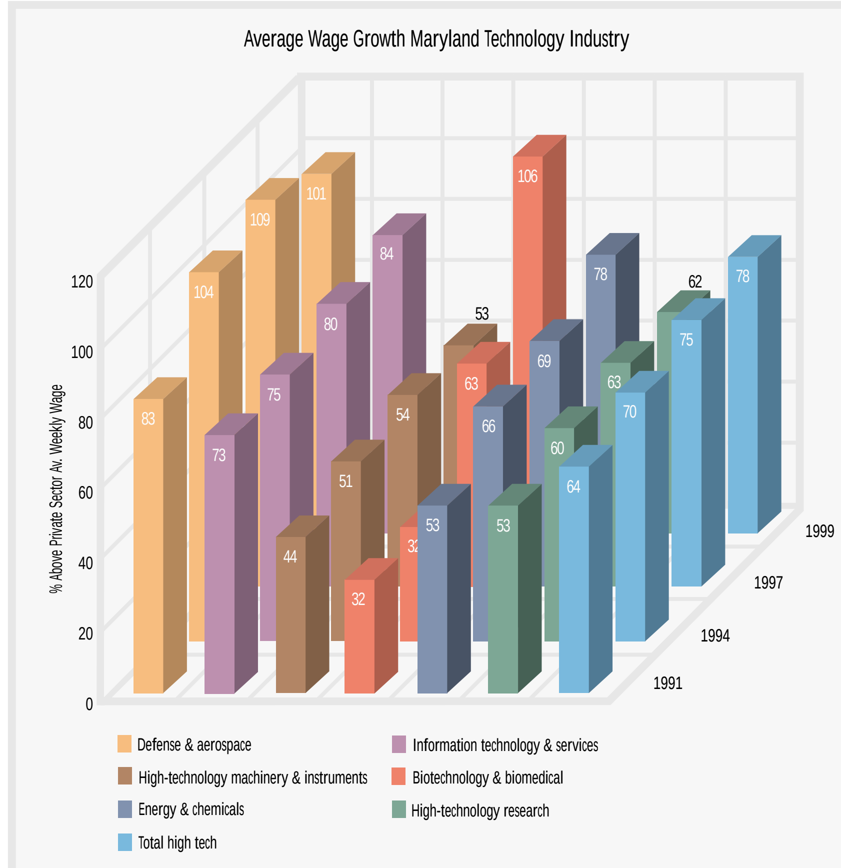
Why measure it?

Because of their high wage levels, technology industries contribute to prosperity and living standards to an extent that is disproportionate to their employment share.

How is Maryland doing?

Maryland high-technology industries entered the decade paying average weekly wages 64 percent higher than the private sector as a whole, and by 1999 had widened the gap to 78 percent. Nationally, this "technology pay-premium" was 80 percent in 1998.

Growth in average weekly wage had been dramatically accelerating in the last several years in bioscience, and increasing modestly in all other technology sectors through 1997. Between 1997 and 1999, technology wage growth in high-technology machinery and instruments, defense and aerospace, and high-technology research just kept pace with total private sector wage growth. Wage growth in bioscience, information technology, and energy and chemicals continued to outpace total wage growth.



Source: Office of Labor Market Analysis and Information, MD Dept of Labor, Licensing & Regulation

Maryland personal income is fifth-highest in the country and growing faster than the national average.

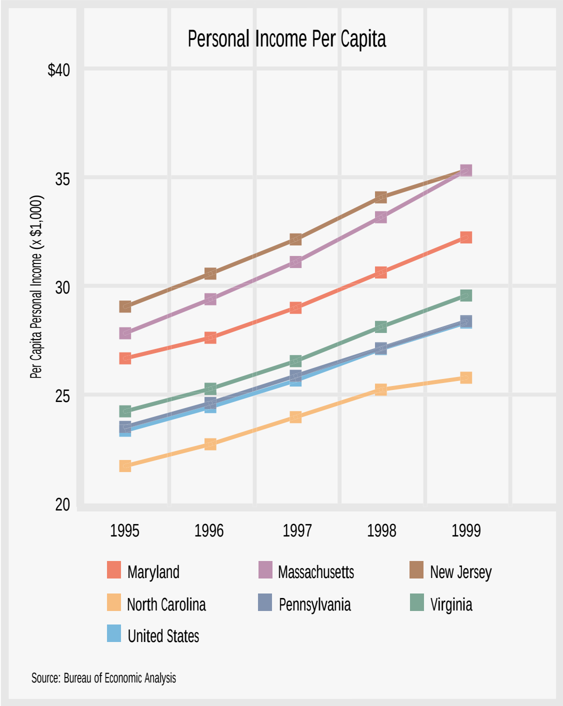
Why measure it?

Widely shared prosperity is the objective of technology-based economic development. Personal income reflects not only the relatively high wages earned by individuals but also the wealth-generating power of a vibrant economy, because it includes the earnings on assets.

How is Maryland doing?

Maryland ranked fifth nationally in per capita personal income in 1999, which at $32,465, was over 13 percent higher than the national average.

In median household income, the state ranked first in the country. Along with employment, income growth is also now accelerating, exceeding the national average in 1999. Maryland also had the U.S.'s highest percentage of its population living above the federal poverty threshold in 1998, above New Jersey (second), Massachusetts (third), Virginia (fourth), Pennsylvania (27th), and North Carolina (36th).



Dynamics

Measures of processes that add management talent, financing and know-how to transform discoveries into products and services with commercial potential, including:

- Intellectual Property
- Strategic Alliances
- Federal Procurement
- Capital
- Labor Quality

Intellectual Property

Indicator 10

Maryland patent rate is below average, increased over the past five years.

Indicator 11

In the last two years, Maryland universities' efforts to commercialize discoveries have begun to pay off.

Strategic Alliances

Indicator 12

Growth in industry-sponsored R&D at Maryland universities is trailing competitor states.

Indicator 13

Maryland small businesses and their university partners have not taken full advantage of the Small Business Technology Transfer (STTR) program's opportunities.

Federal Procurement

Indicator 14

Over three-quarters of federal procurement performed in Maryland is for technology goods and services, including R&D.

Indicator 15

Maryland SBIR awards decline, but the state remains fourth in the nation with improved Phase II performance.

Capital

Indicator 16

Venture capital investment in Maryland technology companies is average among competitor states except Massachusetts.

Indicator 17

Maryland companies have won relatively few Advanced Technology Program awards.

Indicator 18

Capital investment in high-technology manufacturing industries lags in key sectors.

Labor Quality

Indicator 19

Technology manufacturing productivity trails national averages, but is improving rapidly in critical sectors.

Indicator 20

Productivity of technology-services employees has fallen behind competitor states, but is growing rapidly in engineering services and modestly in computer services.

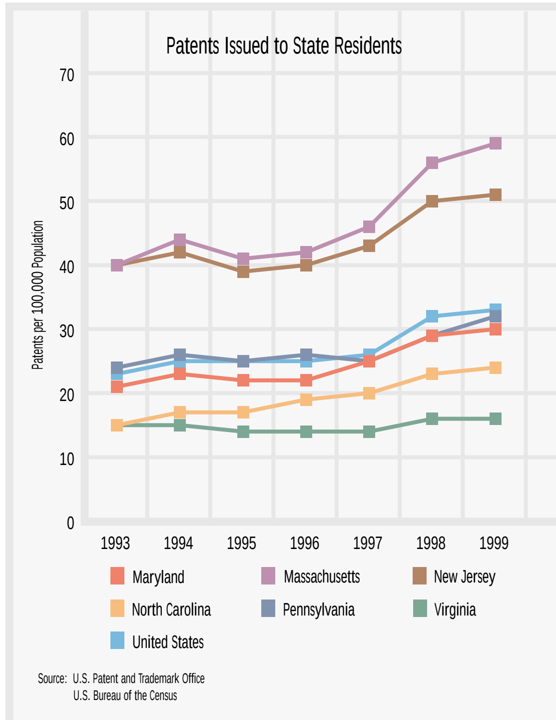
Maryland patent rate is below average, increased over the past five years.

Why measure it?

Patenting is the first step on the path to commercialization after a scientific discovery. Because patents protect intellectual property, they lay the groundwork for gaining a competitive edge when exploiting a discovery commercially.

How is Maryland doing?

Over the past five years, patents issued per capita in Maryland have grown modestly and in 1999 nearly equaled the national average and the performance in Pennsylvania. Patenting intensity appears to run from north to south along the Atlantic coast: Massachusetts and New Jersey were in a separate tier, nearly twice as high as the national average, while Pennsylvania, Maryland, North Carolina and Virginia lagged behind.



In the last two years, Maryland universities' efforts to commercialize discoveries have begun to pay off.

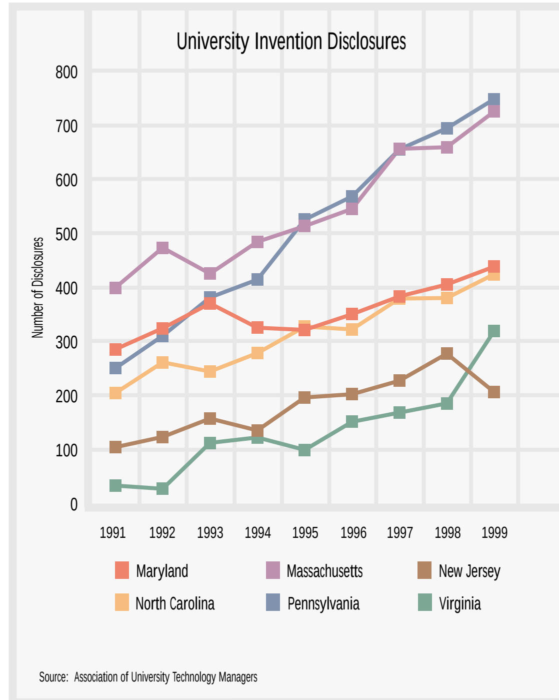
Why measure it?

Maryland universities lead the competitor states in the dollar volume of academically performed research and development. The difference that this advantage makes to the state's economy depends on the degree to which the commercial potential of the results of this research is realized. Evidence of the linkage between research outputs and innovative applications can be found in the intensity with which inventions are disclosed within the university, patent applications filed and patents awarded. An agreement by a company to enter into an agreement to license a technology is a strong signal that the private sector intends to exploit it. License revenues realized from royalty payments provide incontrovertible evidence of commercial sales success. Start-up companies built on inventions licensed from universities, when they locate near the technology source, have the potential to form a node of related commercial activity that, anchored by the university prowess that spawned it, may grow into a new industry cluster.

The Association of University Technology Managers (AUTM) compiles technology licensing reports from universities nationwide; not all universities report each year. As a result, previous years will not precisely match the earlier edition of the *Index*.

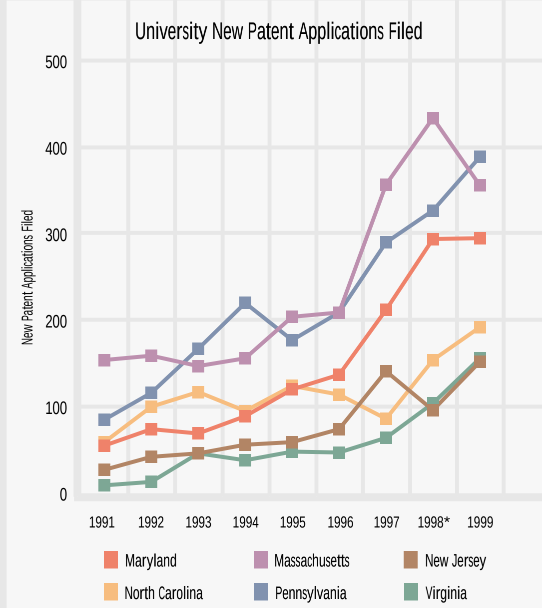
How is Maryland doing?

Invention disclosures, one of the vital inputs in the university technology commercialization process, grew faster in Maryland than the national rate since 1997, a dramatic change over the past two years. Over the decade, however, Maryland, which once ranked second among the competitor states to Massachusetts, has been eclipsed by Pennsylvania, and equaled by North Carolina. Virginia's apparent large increase in 1999 was due to the inclusion for the first time of Virginia Commonwealth University (88 disclosures) and George Mason University (13 disclosures). Without them, the state would have had a modest increase that nevertheless would have overtaken New Jersey.



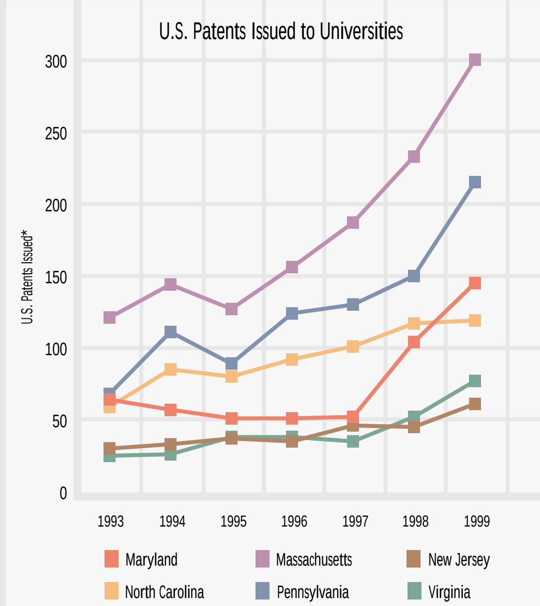
Maryland university technology transfer offices have become much more aggressive than their national counterparts in moving to protect the intellectual property disclosed to them. New patent applications have increased well over fivefold over the decade, a rate exceeded only by New Jersey among the competitor states. Johns Hopkins University filed 77 percent more new patent applications in 1999 than in 1997. Hopkins accounts for almost two-thirds of the state's total. The University of Maryland, Baltimore's applications were up 41 percent. At University of Maryland, Baltimore County and University of Maryland, College Park, 1999 applications dropped below 1997 levels. Maryland new patent filings have increased slightly faster than the national average in the past two years.

Dramatic growth in new patent applications filed in the mid-1990s is beginning to pay off for Maryland



* Includes estimates for non-nine year reporting universities, based on 1997 and 1999 data

Source: Association of University Technology Managers



* For universities reporting at least two years

Source: Association of University Technology Managers

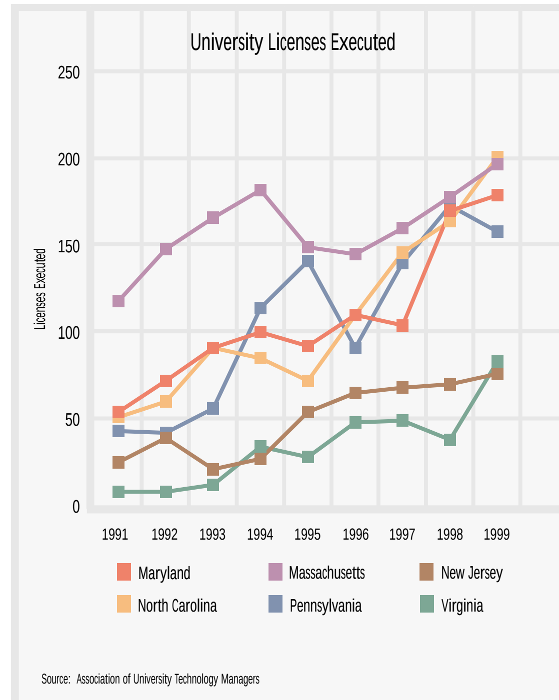
universities. Collectively, they led the competitor group in growth in patents awarded between 1997 and 1999 and ranked solidly third among them in absolute terms in 1999. Johns Hopkins University's 200 percent increase in the past two years brought its total to 111, second to the Massachusetts Institute of Technology (154), which has long received three to four times as many patents as all other universities outside of California. Its 1999 performance put Johns Hopkins ahead of the University of Pennsylvania (82), and Harvard (72), the other leading private universities in the region. The University of Maryland recovered some lost ground in 1998, but slipped back in 1999 and now trails the top public universities in the region. The University of Maryland, Baltimore has made steady progress and equaled College Park's record in 1999.

Because they respond to market forces, executed licenses exhibit a more dynamic pattern within and among states than several of the other indicators. Clearly, those universities that have large patent portfolios have greater potential for executing licenses. The dramatic increase in executed licenses and options at North Carolina universities since 1995 suggests significant new interest by the private sector in discoveries there.

During the 1990s, licensing in Maryland institutions grew by 231 percent, 13 percent above the average of all U.S. universities. Aggressive patenting in the mid-1990s by these institutions paid off in higher licensing rates in the last two years. In particular, Hopkins executed more than two times as many licenses in 1999 as in 1997. Licensing at the University of Maryland institutions has grown at the national average rate, about 22 percent.

Maryland totals for 1999 were aided by the addition of the University of Maryland Biotechnology Institute (UMBI) to the AUTM survey. UMBI executed four licenses and received $333,000 in license income.

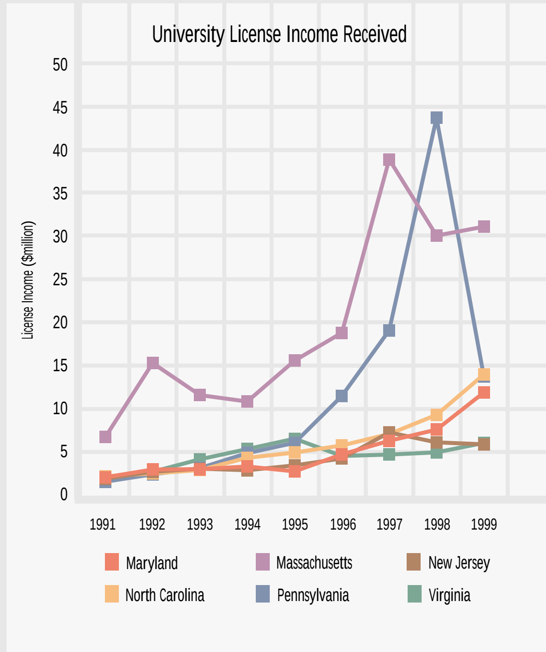
The cumulative effect of these licenses has begun to be enjoyed in burgeoning streams of licensing income,



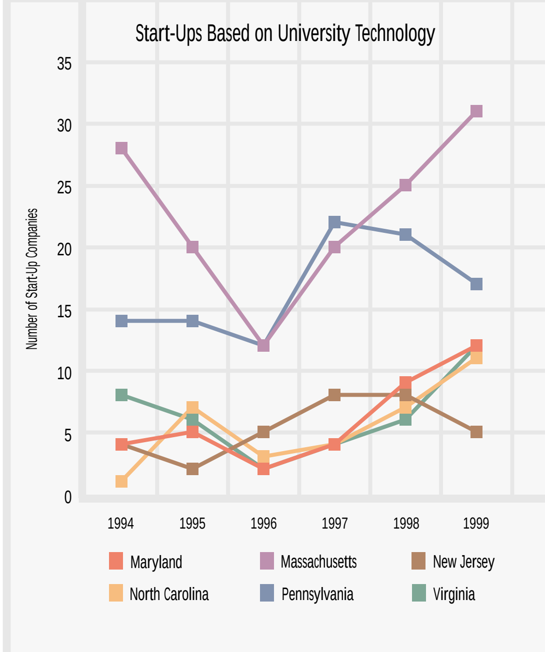
Source: Association of University Technology Managers

particularly at Johns Hopkins (125 percent increase between 1997 and 1999 following a 150 percent jump between 1995 and 1997). Johns Hopkins, which ranked 16th nationally in 1999, received $10.4 million in 1999 on 137 licenses and $5.5 million in 1998 on 149 licenses (ranked 18th in the U.S.). A $27 million windfall at Carnegie Mellon in 1998 was not sustained in 1999; a similar peak occurred at Harvard in 1997.

New enterprise creation based on Maryland university-licensed technology trebled in the last two years, while national increases slowed to 6.6 percent. Similarly strong performances in Virginia and North Carolina (primarily based on NC State technologies) have brought the three states into a virtual tie behind a slumping Pennsylvania and a once-again airborne Massachusetts. Three of the Virginia start-ups were attributable to Virginia Commonwealth University, new to the analysis in 1999. North Carolina State University was responsible for eight of North Carolina's 11 start-ups.



Source: Association of University Technology Managers



Source: Association of University Technology Managers

Growth in industry-sponsored R&D at Maryland universities is trailing competitor states.

Why measure it?

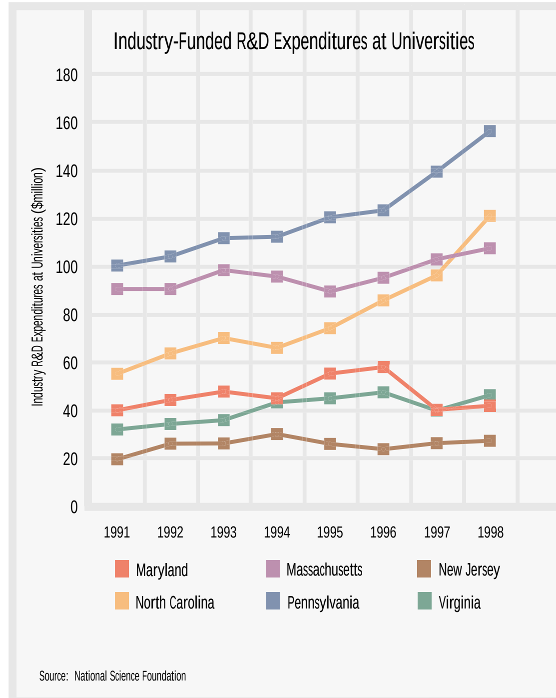
High-technology companies that work with universities experience higher growth rates than companies that do not. Industry sponsorship of R&D at universities not only expands support for the institutions that have seen federal sources threatened, but also clearly benefits the sponsors. Nationally, industry funding of research and development has increased 8.5 percent per year in real terms between 1994 and 2000, while federal funding has increased only 1.0 percent annually.

The National Science Foundation's survey of research expenditures at colleges and universities reports the location of the universities but not the industry sponsors. The data reported here, then, measure not the level of Maryland industry's relationships with universities, but the degree to which Maryland universities are doing work of interest to industry nationally (and internationally) and have policies and systems in place to attract and manage industry sponsorships.

How is Maryland doing?

Over the second half of the 1990s, institutions in Pennsylvania (led by Penn State) and North Carolina (led by Duke and North Carolina State) appear to be sharply increasing their capacity to attract industry R&D allies, while Massachusetts, Virginia and New Jersey appear to have stagnated.

In a turnaround since 1996, industry sponsorship of R&D at Maryland universities has declined dramatically. Maryland's ranking nationally dropped from ninth to 15th between 1996 and 1998. With modest increases in the second half of the 1990s, the University of Maryland, Baltimore moved into the lead among the state's institutions in industry-sponsored R&D after a precipitous drop in industry funding of research at University of Maryland, College Park between 1996 and 1997. Industry-sponsored R&D also increased at Johns Hopkins University, though growth slowed.



Summary
Performance
Dynamics
Resources
Appendix

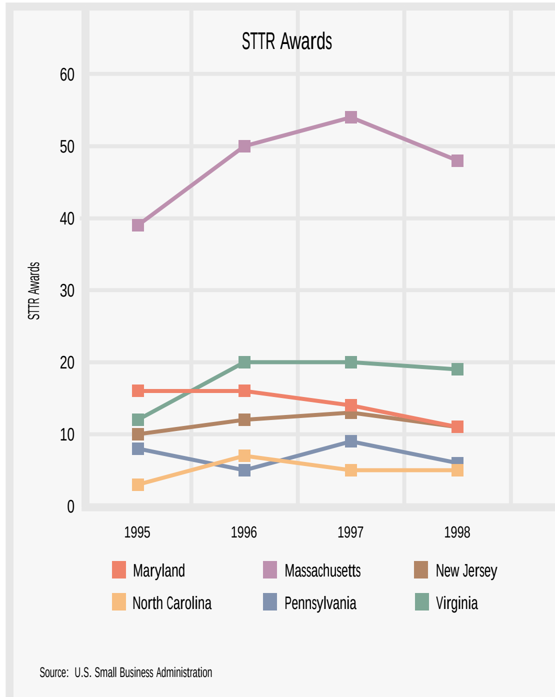
Maryland small businesses and their university partners have not taken full advantage of the Small Business Technology Transfer (STTR) program's opportunities.

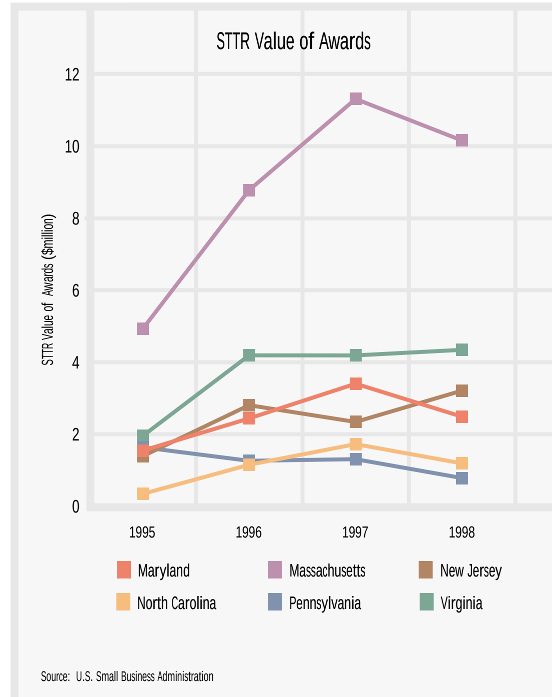
Why measure it?

The Small Business Technology Transfer program (STTR) provides R&D funding from federal agencies on the same basis (but in smaller percentages) as the Small Business Innovation Research (SBIR) program, but only to partnerships of small businesses and universities. The data provide another clue about the extent to which Maryland companies are looking to alliances with universities to pursue their R&D objectives.

How is Maryland doing?

After a relatively fast start (behind Massachusetts, behind but then overtaking Virginia), Maryland appears to be losing competitive ground as the total program has grown from its initiation in 1992. In 1998, companies in all the competitor states except North Carolina won fewer awards. Only New Jersey and Virginia saw award levels increase in 1998. The number of





SUMMARY
PERFORMANCE
DYNAMICS
RESOURCES
APPENDIX

Maryland awards dropped 22 percent, second to Pennsylvania (-33 percent) and award values were down 28 percent, behind Pennsylvania (-42 percent) and North Carolina (-32 percent).

Over three quarters of federal procurement performed in Maryland is for technology goods and services, including R&D.

Why measure it?

The federal government is largely responsible not only for Maryland's leadership in research and development, but also for the strong presence of high-paying information technology and technology services companies in the state. Tracking the federal expenditures in key technology sectors back to their source enables policymakers to assess the impact that changes in federal policy may have on the Maryland economy, and to identify areas in which collaboration across federal and corporate lines might be fruitful.

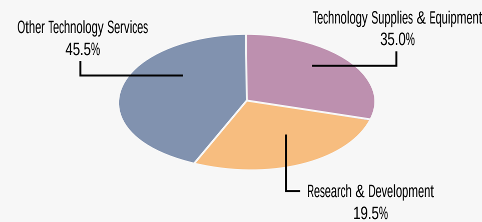
How is Maryland doing?

According to the U.S. General Services Administration (GSA), in federal FY1999, Maryland ranked fourth in total federal procurement, the same as the previous year. Of the top ten states, Virginia ranked second, Massachusetts eighth and Pennsylvania ninth. Between FFY 1998 and FFY 1999, total procurement in Maryland was down, from $10.4 to $10.3 billion.

Not all federal procurement is for technology-related goods and services. Using GSA's federal product service codes, a close analysis of individual federal procurements for FFY 1999 (October 1998 through September 1999) reveals that, once again, over three quarters of the dollar value, or $8 billion, was for technology-related items.

Of the technology-related procurements, 35 percent was for technology supplies and equipment, particularly guided missile launchers, computer-related equipment and communications / detection equipment (including radar). Within the 46 percent for other technology services, computer-related services accounted for the largest portion, followed by engineering technical services. Research and development accounted for 20 percent of the total, led by space, weapons, aircraft and other defense R&D procurements. It should be noted that a significant amount of research and development is not reflected in these statistics because the agreements between federal agencies and performers are grants rather than contracts. Federal R&D obligations data presented in the RESOURCES section provide a more complete picture.

Federal Technology Procurement Performed in Maryland



Total: $7.9 billion

Source: Federal Procurement Data System, Johns Hopkins Institute for Policy Studies

Maryland SBIR awards decline, but the state remains fourth in the nation with improved Phase II performance.

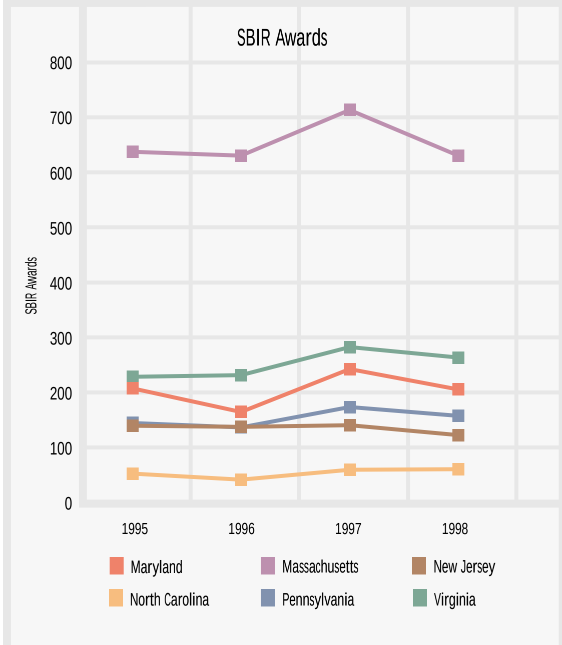
Why measure it?

The Small Business Innovation Research program (SBIR) continues to be an important source of R&D funding for innovative companies. The federal government sets aside 2.5 percent of its procurements of research and development and conducts a special competition among small (under 500 employees) companies for the awards. Depending on the policy of the federal agency involved, Phase I awards for proof of concept work can be made for as much as \$100,000, while Phase II awards for technology development can total up to \$750,000 (or \$1 million in special cases). The program rewards innovation and is giving increased weight to applicants' demonstrated plans and capability for commercialization of federally funded R&D. SBIR awards provide R&D funding that helps recipients with initial technology development and, as they mature, extensions of their core technologies, all without requiring them to give up equity or incur debt.

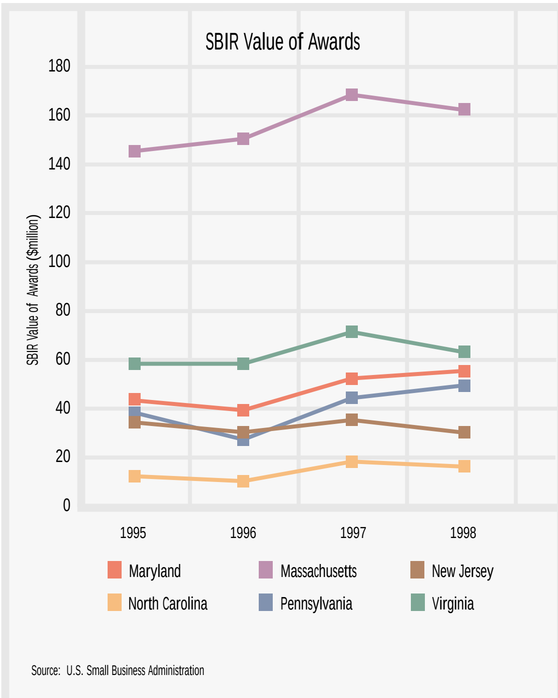
How is Maryland doing?

As might be expected in such a federally oriented technology community, Maryland has consistently ranked among the top five states in the country (fourth in 1998), both in number of SBIR's and value of awards. Among the competitor states, Massachusetts (second) and Virginia (third) rank higher. Massachusetts' totals were three times those of Maryland. Maryland lost ground to Virginia on Phase I awards between 1997 and 1998 but had almost caught up in Phase II awards. Since the latter provide larger grants and contracts for prototyping and other steps toward commercialization, Maryland's recent performance is cause for celebration.

All the states except North Carolina won fewer



Source: U.S. Small Business Administration



awards in 1998 than in 1997. Maryland and Pennsylvania were the only two states to see higher award values, because of an increase in the proportion and size of the awards that were for Phase II projects.

Venture capital investment in Maryland technology companies is average among competitor states except Massachusetts.

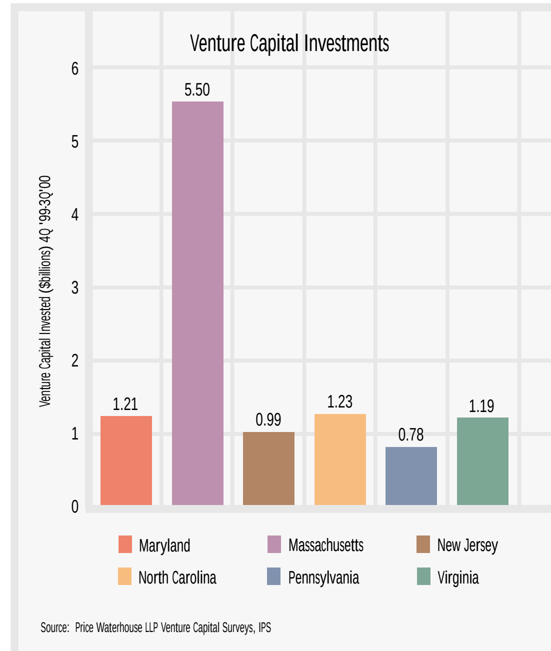
Why measure it?

According to a recent analysis done for the Federal Reserve Board, only 1.85 percent of small-business finance comes from venture capital. However, venture capital flows to the companies with the greatest growth potential. In the third quarter of 2000, 96 percent of all venture investments were made in technology companies nationally. The comparison presented here is of investments in technology companies only.

How is Maryland doing?

Despite the fact that Maryland is home to a significant concentration of venture capital partnerships, technology companies in the state have not attracted a proportional share of venture capital investments. Between 1999 and 2000, Maryland's position within the competitor states group improved from sixth to third, in a virtual dead heat with North Carolina and Virginia but out of sight of the leading Massachusetts. With the exception of Massachusetts, the differences among the states in venture capital attracted do not appear to be related to the number or percentage of technology-intensive start-ups or fast-growing “gazelles.” Almost one third of North Carolina's total for 2000 was attributable to one large ($400 million) investment in a telecommunications firm.

Among the competitor states, Massachusetts dominated all industry categories except pharmaceuticals, in which Pennsylvania led. The maturation of North Carolina's bioscience sector is apparent in its second-place ranking in biotechnology investments, $138 million compared to Maryland's $10 million. Maryland ranked low among the competitor group of states in all industries except telecommunications, which accounted for over $800 million of the venture capital invested in the state in 2000. Four of the five competitor states



enjoyed higher levels of venture capital investment in software companies, Maryland's second largest technology industry. Virginia software companies attracted almost three times as much capital as did those in Maryland.

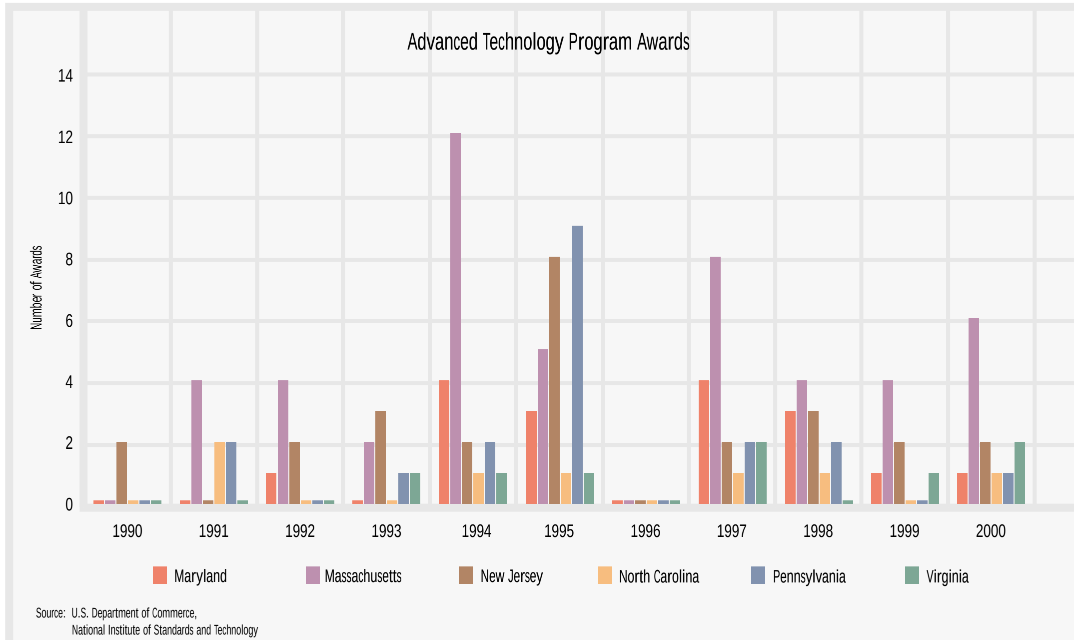
Nationally, the volume of venture capital investments almost doubled from the third quarter of 1999 to the third quarter of 2000. The states profiled here experienced far greater increases in annual totals between the two years: Maryland led with a 880 percent increase, followed by Virginia (640 percent), New Jersey (500 percent), North Carolina (490 percent), Massachusetts (390 percent) and Pennsylvania (330 percent).

In analysis by the U.S. Department of Commerce's Technology Administration, venture capital funds invested for 1998 were normalized using state Gross State Product. Maryland ranked seventh in the country, behind Massachusetts (first) and Virginia (sixth), and ahead of North Carolina (11th), Pennsylvania (17th), and New Jersey (18th).

Maryland companies have won relatively few Advanced Technology Program awards.

Why measure it?

The U.S. Department of Commerce National Institute of Standards and Technology's Advanced Technology Program (ATP) awards funds to projects that meet two tests: breakthrough, high risk technology and strong commercialization capability. The funding may be used for all research and development activities short of actual product development. Single companies may apply for up to $2 million over three years. There is no limit on the amount that joint ventures may request for projects lasting up to five years. The total amount of funding available for awards has varied greatly from year to year, so the state's performance is best evaluated relative to other states each year rather than over time. In FFY 2000, $50.7 million was available for first year funding of new projects.



How is Maryland doing?

Maryland companies were slow to seize the opportunity represented by ATP, but through 1998 competed successfully for these "pre-competitive" research and development funds. In each of the last two years, however, only one Maryland company won an award, either as a sole applicant or as part of a joint venture—Cytimmune Sciences in 1999 and Genex Technologies in 2000.

The majority of the Maryland projects have been related to biotechnology or the application of information technology to biology and/or health care.

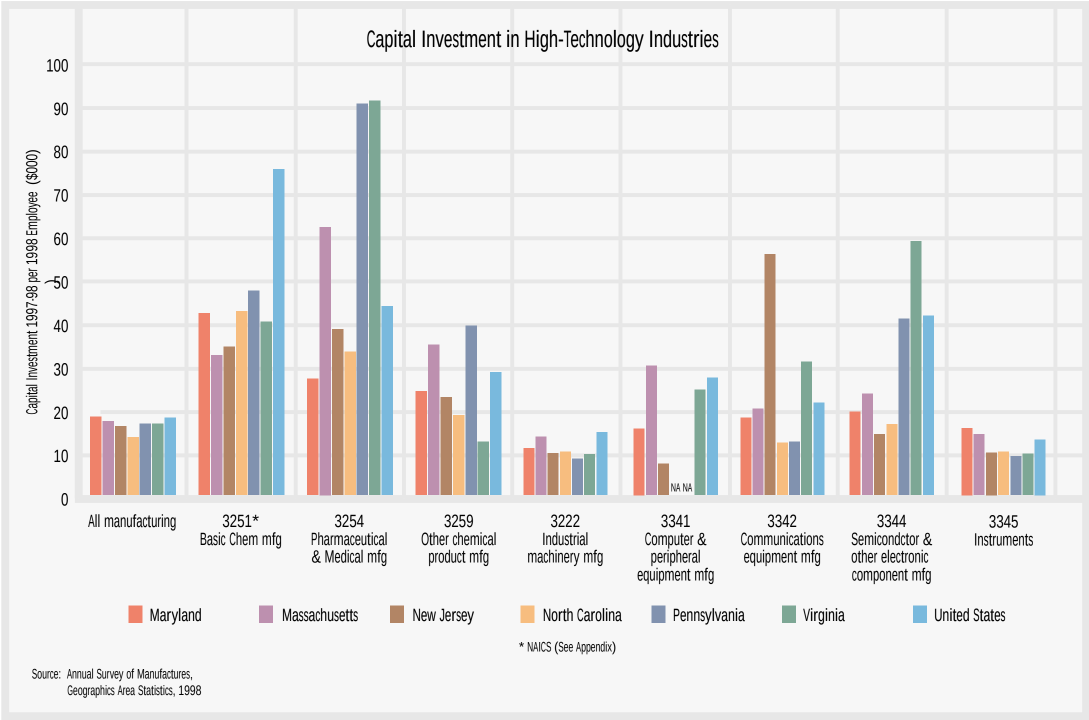
Capital investment in high-technology manufacturing industries lags in key sectors.

Why measure it?

Capital investment enhances the productivity of labor and sets the stage for further growth in employment and output.

How is Maryland doing?

In 1998, total new capital investment per employee in Maryland slightly exceeded the national average in all manufacturing industries, an improvement over the previous four years. In technology industry categories, however, the record is mixed. In its largest technology manufacturing categories, Maryland: 1) trailed New Jersey, Virginia, Massachusetts and the national average in communications equipment, 2) significantly lagged all the states and the national average in pharmaceuticals, and 3) was lower than all but New Jersey and North Carolina in electronic components. Maryland's performance was competitively better



in smaller sectors—better than all states and the national average in instruments, and competitive in basic chemicals and industrial machinery. There is still hope that updated pharmaceutical figures will show improvement, given the significant new bioprocessing manufacturing facilities that have been built in the state in the past several years.

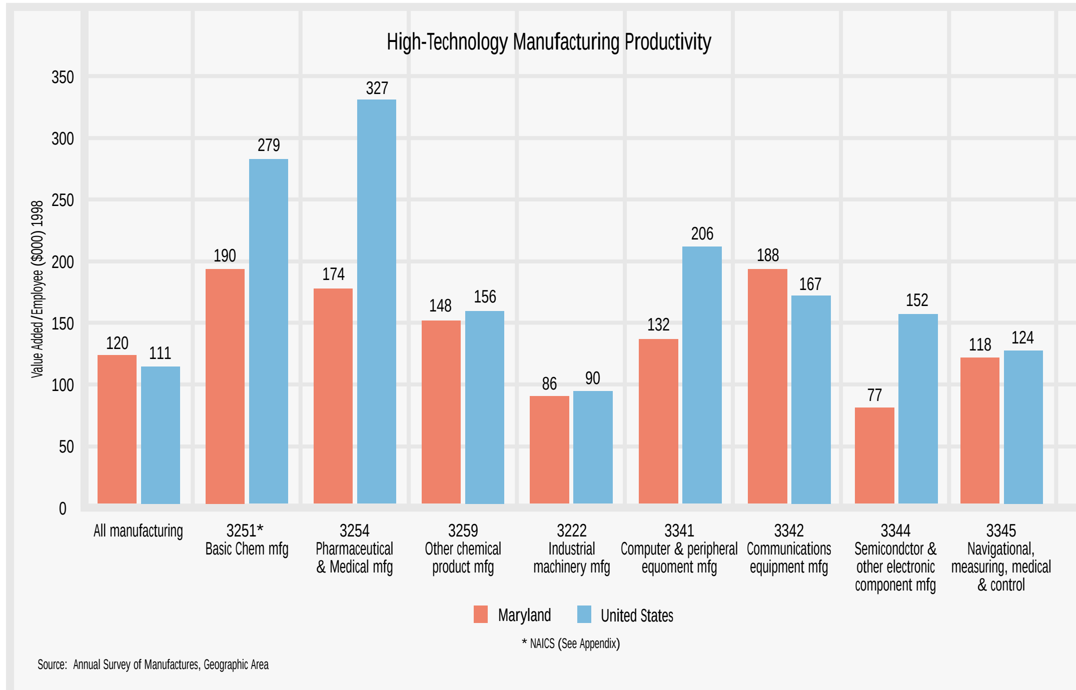
Technology manufacturing productivity trails national averages, but is improving rapidly in critical sectors.

Why measure it?

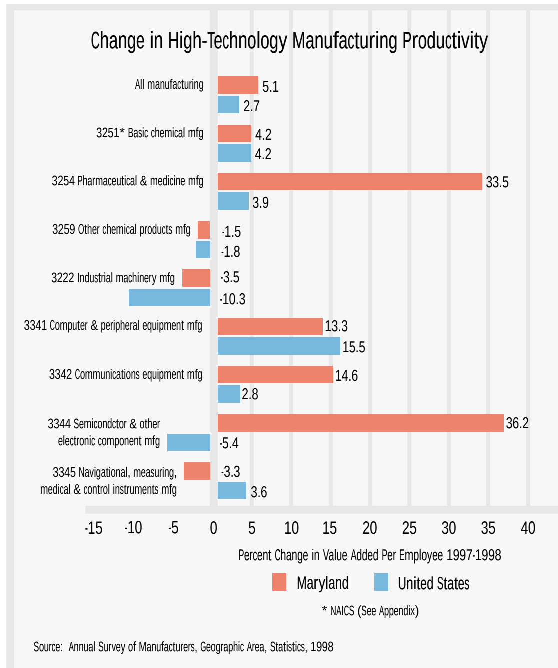
Value added per employee is the best measure available for gauging the net additional economic contribution of manufacturing sectors, since it subtracts from the value of total shipments the cost of inputs such as materials, supplies, containers, fuel and purchased electricity, and contract work. It is used as a means of comparing the productivity of labor, and reflects the capital intensity of an industry sector.

How is Maryland doing?

While overall value added per manufacturing employee in Maryland exceeded the U.S. average in both 1997 and 1998, the state's record across technology industries (using NAICS classifications) is mixed. In the state's largest technology manufacturing sector, communications equipment, productivity grew much faster than the national rate, and now



exceeds the U.S. average. In the second-largest sector, pharmaceutical and medicine manufacturing, Maryland productivity was less than half that of the national average, but grew 33 percent from 1997 to 1998 as the sector matured into a more capital-intensive phase. Productivity in semiconductor and electronic component manufacturing, the third-largest Maryland technology manufacturing industry, also lagged but was growing rapidly. Only in instruments (NAICS 3345), the fourth-largest segment that had productivity of roughly the national average, was productivity declining in Maryland while increasing in the U.S.



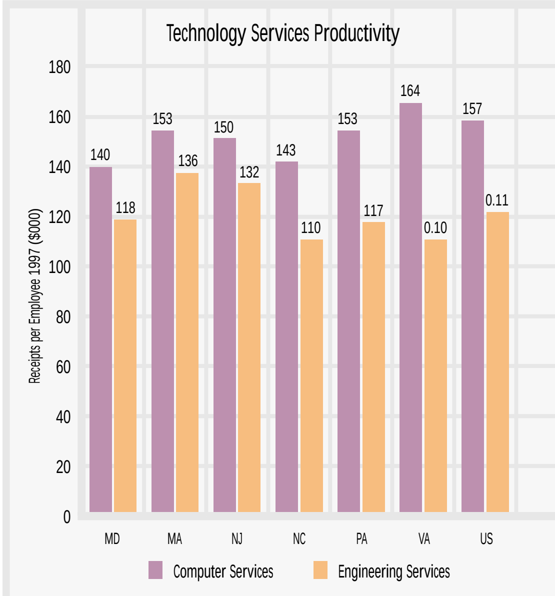
Productivity of technology services employees has fallen behind competitor states, but is growing rapidly in engineering services and modestly in computer services.

Why measure it?

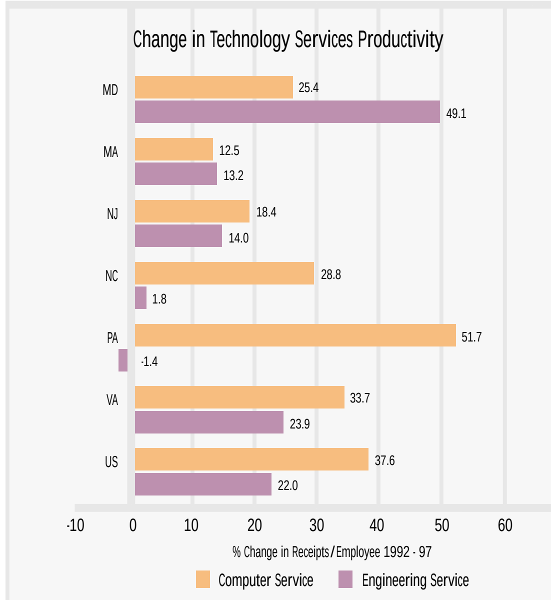
Receipts per employee is the generally used measure of productivity in the services sector. Given the dominant role that service sectors play in Maryland's high technology, and their labor intensity, the state's technology future very much depends on the productivity of high-technology services workers compared to other areas. The most recent data is newly available from the U.S. Census Bureau for 1997, and is based on the new North American Industrial Classification System (NAICS).

How is Maryland doing?

Productivity in computer services, one of the state's largest industries, trailed all the competitor states and was 11 percent lower than the national average in 1997. Engineering services productivity lagged the national average by two percent and ranked third among the competitor states. Productivity grew at only two-thirds the



Source: U.S. Department of Commerce, Bureau of the Census, Census of Service Industries (1987, 1992), 1997 Economic Census



Source: U.S. Department of Commerce, Bureau of the Census, Census of Service Industries (1987, 1992), 1997 Economic Census national rate in computer services, but 123 percent faster in engineering services. Disclosure issues in data for the research and development sectors that constitute another large portion of Maryland technology services employment prevent analysis of productivity and growth in these industries.

RESOURCES

Measures of the human, intellectual, financial and physical capital that provides the infrastructure for innovation, including:

Business Base and Entrepreneurial Culture
Intellectual Resources
Human Resources
Financial Resources
Digital Infrastructure and Access

Business Base and Entrepreneurial Climate

Indicator 21

The rate of new company creation is higher than all competitor states, and young companies make up almost a quarter of the business base.

Intellectual Resources

Indicator 22

Maryland is among the most R&D-intensive states in the country.

Indicator 23

Maryland's R&D is extraordinarily dependent on federal funding.

Indicator 24

U.S. Dept. of Health and Human Services funds 41 percent of federal R&D performed in Maryland. Over 11 percent of all federal R&D spending in the U.S. is performed in Maryland.

Human Resources

Indicator 25

Increasing percentages of Marylanders hold high school and college degrees, and a large portion of them are in the labor force.

Indicator 26

Highly educated scientists and engineers have the potential to give Maryland a significant advantage over other states.

Indicator 27

Biological sciences and engineering lead Maryland doctorates.

Indicator 28

Science and engineering graduate student enrollment as a percentage of the young adult population is on par with competitor states; strong participation by African-American students.

Indicator 29

Higher education performance in Maryland is highly rated except on affordability.

Indicator 30

Maryland public school student scores are average on standardized tests.

Indicator 31

Workforce is concentrated in technology occupations, particularly biological sciences and computer-related professions.

Indicator 32

Wages earned in technology occupations are competitive with other leading technology states.

Financial Resources

Indicator 33

Maryland and surrounding states are home to one of the largest concentrations of venture capital under management in the country.

Digital Infrastructure and Access

Indicator 34

Telecommunications infrastructure meets requirements of high-technology companies.

Indicator 35

Computers in the home and household Internet access in Maryland are average among top-tier states.

Indicator 36

Maryland is ahead in school Internet access and digital government, but lags in teacher participation and skills.

The rate of company creation is higher than all competitor states, and young companies make up almost a quarter of the business base.

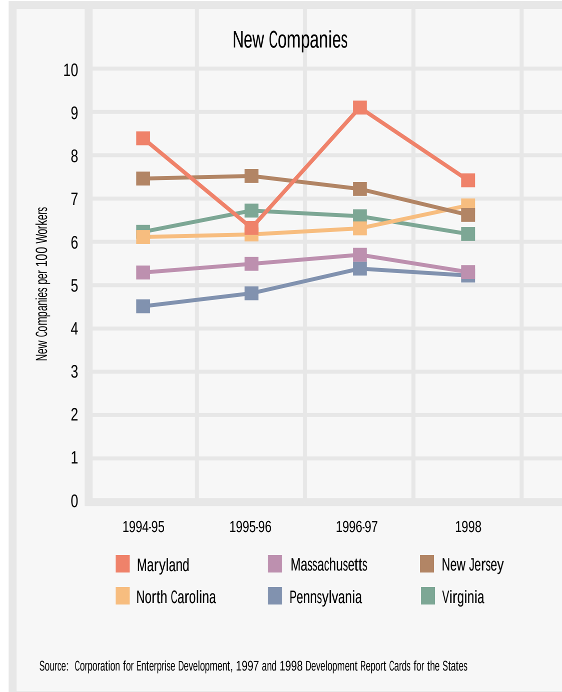
Why measure it?

The rate at which entrepreneurs launch new companies signals the perceived health of the state's economy and determines its future vitality. Confidence about the state's economic environment leads a business founder to risk creating a new enterprise. The dynamism feeds on itself, attracting other entrepreneurs and the specialized services that support their endeavors, and fuels economic growth. New company creation is shown relative to total employment in order to normalize data across state economies of varying sizes.

How is Maryland doing?

In 1998, 7.4 new companies were formed in Maryland for every 1,000 workers. This ranked the state 17th nationally, and well ahead of competitor states (Massachusetts was ranked 35th, New Jersey 20th and Virginia 22nd). The new enterprise creation rate has shown extreme volatility over the past several years: Maryland also led the group in new company formation last year and three years ago, but dropped precipitously two years ago—the largest one-year decline in the nation—before rebounding in 1997 with the largest gain in the country. This atypical pattern may be attributable to the timing of reporting to the federal agency that is the source of this data, but a three-year rolling average still gives Maryland a leading position. Only North Carolina (ranked 19th nationally) experienced increases in new company creation rates between 1997 and 1998.

Maryland's business base in 1998 was comprised of a relatively youthful distribution of companies. According to Cognetics, 22.7 percent of its firms were less than five years old, second behind New Jersey (25.3 percent), and ahead of Virginia (22.4



percent), North Carolina (20.9 percent), Massachusetts (17.7 percent) and Pennsylvania (15.2 percent).

Patent attorneys and agents, who provide important business services for growing technology companies, made up a larger portion of Maryland's business base in 1999 (37.7 per 10,000 business establishments) than the national average. Maryland ranked 10th nationally, and fourth among the competitor states behind Virginia (68.9), Massachusetts (52.8), and New Jersey (43.2), and ahead of Pennsylvania (33.8) and North Carolina (17.2).

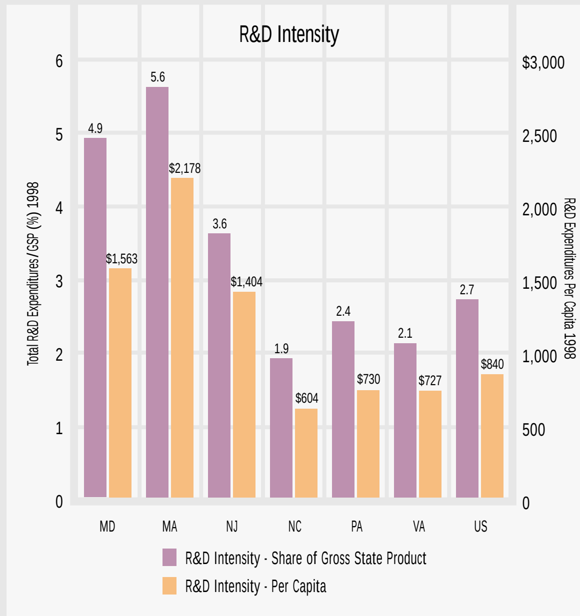
Maryland is among the most R&D-intensive states in the country.

Why measure it?

Research and development are the first steps on the path toward technology-driven economic growth. A healthy research-and-development base is a necessary, though not sufficient, foundation for commercially relevant innovation.

How is Maryland doing?

Research and development accounted for 4.9 percent of Maryland's Gross State Product in 1998, the third- highest in the country and an increase from 4.7 percent in 1996. Of the competitor states, only Massachusetts ranked higher. Nationally, R&D's share of Gross Domestic Product was 2.67 percent in 1998, the highest level since 1991. In absolute terms, Maryland ranked tenth nationally in total R&D. Three of the states that exceeded its totals were among the competitor states (Massachusetts, New Jersey and Pennsylvania). On a per capita basis, among the competitor states Maryland once again trailed only Massachusetts.



Sources: National Science Foundation; Bureau of Economic Analysis; U.S. Census Bureau

Maryland's R&D is extraordinarily dependent on federal funding.

Why measure it?

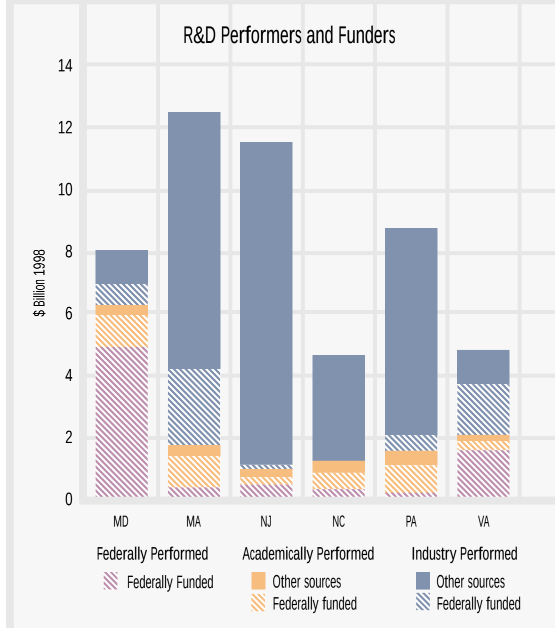
The R&D foundations that give rise to Maryland's innovation potential are dramatically different than those of any other state. Only by understanding the character and funding of R&D in the state can strategies for enhancing its position and identifying new opportunities be formulated.

How is Maryland doing?

More federal research and development is performed in Maryland than in any other state. The federal government funded $4.8 billion of intramural research conducted in Maryland in 1998, more than twice as much as the next highest state, California, and up from $4.2 billion in 1995.

Nationally, 14 percent of R&D is performed by universities. Maryland universities conducted 17 percent of total R&D in the state, exceeded by North Carolina, where 20 percent of R&D was performed by universities. Universities in Maryland, Massachusetts and Pennsylvania had R&D expenditures in 1998 of $1.3 billion each, the highest among the competitor states. The federal government funded a larger percentage of university R&D in Maryland than in any of the competitor states. Johns Hopkins University received more federal funding than any other university in the country.

In industry-performed R&D, Maryland fell well behind the competitor states in 1998, and 19th in the nation (up from 24th in 1995). Maryland is also unusual in the large percentage (38 percent) of industry R&D that was funded by the federal government, a share that has increased from 27 percent in 1995. Industry-performed research in Maryland achieved a record high (over $2 billion) in 1993 due to the infusion of large amounts of federal funding, then dropped back to just over $1 billion in 1995. Since 1995 it has grown 62



Source: National Science Foundation; Johns Hopkins Institute for Policy Studies percent. A portion of this growth has been the result of outsourcing by federal agencies to industry contractors, but industry-funded, industry-performed R&D grew from $788 million to $1.1 billion in that time (38 percent increase).

In Virginia, the next lowest-ranking state, industry performed 56 percent more R&D than in Maryland, while in other competitor states, industry was responsible for seven to eight times as much R&D. Once again, however, only in Virginia, where government contractors make up a similarly large percentage of the high-technology sector, did industry receive a larger percentage (60 percent) of its R&D funding from the federal government.

In total, the federal government supported 80 percent of the research and development conducted in Maryland, down from 84 percent in 1995. By contrast, 28 percent of all research performed in Massachusetts (37 percent in 1995) and 68 percent in Virginia (down from 74 percent) were federally funded. The U.S. average was 27 percent.

U.S. Dept. of Health and Human Services funds 41% of federal R&D performed in Maryland.

Why measure it?

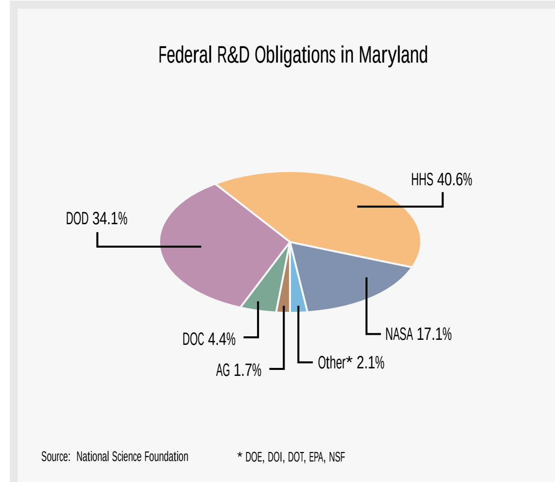
Maryland's extraordinary dependence on federal funding for the underpinnings of its technology sector requires close monitoring of the ebbs and flows of federal funds. Each federal agency plays a different role in the state's technology infrastructure, and is subject to variable funding pressures.

How is Maryland doing?

The U.S. Department of Health and Human Services (primarily the National Institutes of Health) supported half of the research and development performed intramurally within federal laboratories located in Maryland in 1998, and accounted for almost half the federal support of university R&D in the state. Only 13 percent of federal support for industry R&D came from HHS, a decline from 1997's share of 18 percent.

The Department of Defense funded 32 percent of the federal intramural R&D performed in Maryland in 1998, virtually unchanged from 1997. DoD also supported the largest share (48 percent) of federally underwritten R&D performed by industry and 26 percent of R&D by universities in the state. In competitor states, with the exception of North Carolina (which is home to an HHS facility as well as several leading medical schools), DoD was the preeminent federal underwriter of R&D.

Because of the location of Goddard Space Flight Center (GSFC), the National Aeronautic and Space Administration (NASA) plays a significant role in Maryland's federal R&D funding picture, accounting for 17 percent of the total in 1998. Because of the extensive and growing use of contractors at GSFC, the largest share of NASA R&D support to Maryland performers was to industry, totaling 37 percent of the federal support for industry R&D, a dramatic increase since 1997 (29 percent). Maryland universities also benefit from their proximity to Goddard and to NASA headquarters in

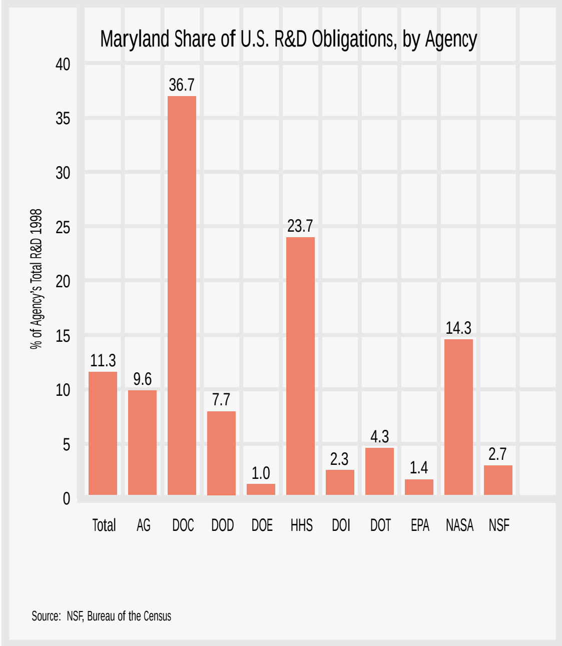


Washington, D.C.: NASA funded 16 percent of their federally underwritten R&D.

Unusual among the competitor states and solely because of the location of the National Institute of Standards and Technology (NIST) in Gaithersburg, the Department of Commerce (DOC) figures in Maryland's R&D infrastructure. In addition to its laboratories, DOC's National Oceanic and Atmospheric Administration also has a large presence in the state.

When examined in a national context, Maryland, which is home to less than two percent of the nation's population, enjoyed over 11 percent of all federal R&D spending in 1998, up from 10 percent in 1997. Almost 10 percent of the Department of Agriculture's R&D, more than a third of the Department of Commerce's, nearly eight percent of all defense R&D, almost a quarter of all health R&D, and over 14 percent of NASA R&D obligations (up from 10 percent in 1997) were made in Maryland.

A recent analysis by the RAND Corporation used the Consolidated Federal Funds Report of the U.S. Census Bureau to analyze all activities in states that were paid for using federal funds defined as R&D. It found Maryland to be the second-ranked state (behind California) in total estimated federal R&D outlays in FY98, first in the share of all the federal funds flowing to the state and its citizens that were devoted to R&D, and first in federal R&D funds per capita.



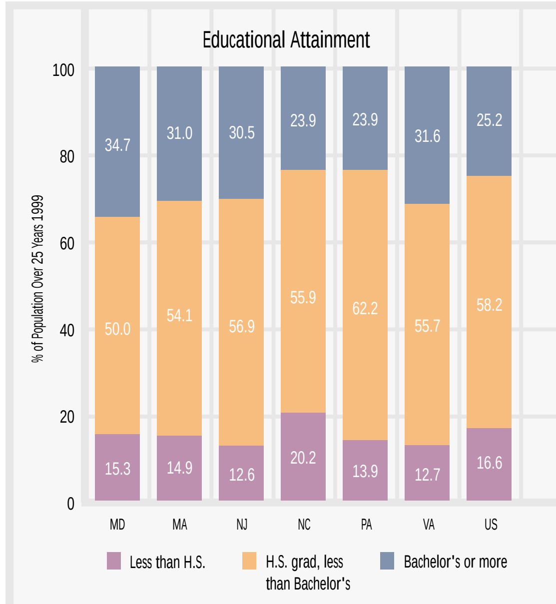
Increasing percentages of Marylanders hold high school and college degrees.

Why measure it?

The size and quality of the labor force is of vital importance to technology-intensive industries. Increasingly, work in even non-technology-based businesses requires critical reasoning, computing and communication skills.

How is Maryland doing?

Maryland leads the competitor states in labor participation rate (69.9 percent). Another dramatic increase over the past two years in the percentage of its citizens holding Bachelor's degrees or more propelled Maryland to the top ranking among the competitor states, and well ahead of the national average. But over 15 percent of Maryland's population over 25 years of age had less than a high school education in 1999, second highest among these states.



Source: U.S. Bureau of the Census, Current Population Survey; Johns Hopkins Institute for Policy Studies

Highly educated scientists and engineers have the potential to give Maryland a significant advantage over other states.

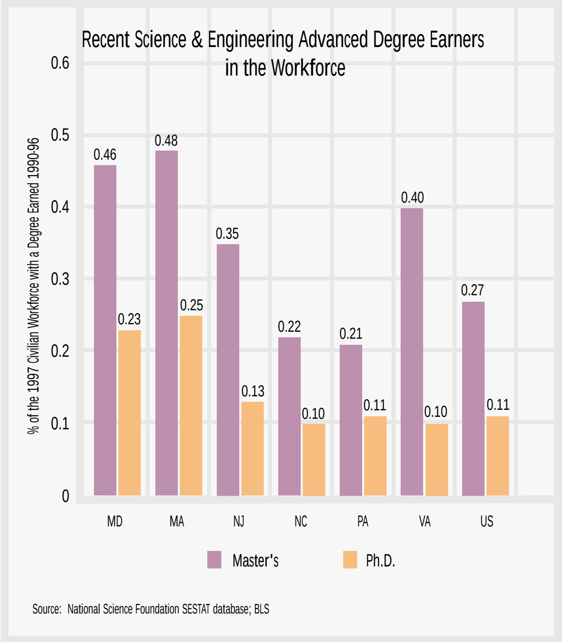
Why measure it?

Scientists and engineers who have earned Master's and Doctoral degrees represent a fundamental resource for innovation, which begins with discovery. New knowledge and the application of that knowledge form the nucleus around which innovative companies are formed and continue to grow. This new measure, which focuses on individuals who recently earned advanced degrees in science or engineering, also gauges how attractive places are to these highly prized workers.

How is Maryland doing?

In 1997, Maryland was among the top three states in the country in the percentage of its workforce that earned a Master's degree (second behind Massachusetts) or Ph.D. (third behind Massachusetts and New Mexico) degree in science and engineering in the 1990s. Almost 13,000 recent recipients of science or engineering Master's degrees, and 6,400 recent Ph.D. recipients were employed in Maryland in 1997.

Maryland higher education institutions also granted 3,640 Bachelor's degrees in science and engineering in 1997, 17 percent of the total Bachelor's degrees they awarded, which ranked the state 18th. Massachusetts ranked 13th, New Jersey 12th, North Carolina sixth, Pennsylvania 14th and Virginia eighth on this measure of the science and engineering orientation of the state's higher education institutions.



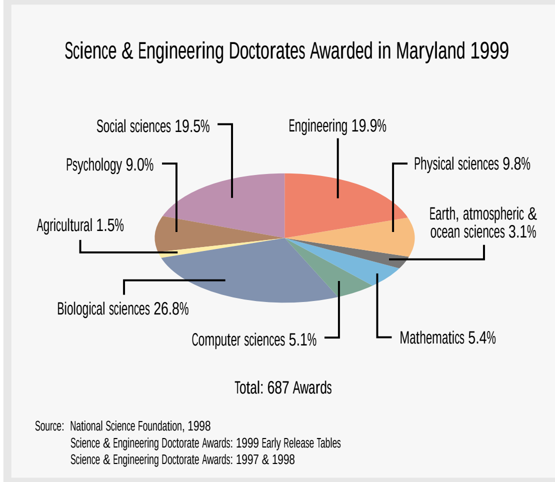
Biological sciences and engineering lead Maryland doctorates.

Why measure it?

Examining the fields within which doctorates are earned reveals the relative strengths of Maryland institutions of higher education and their students.

How is Maryland doing?

It is clear that Maryland's strength in life sciences is not only the result of the location of the National Institutes of Health and the Food and Drug Administration but also the production by its universities of new Ph.D.s in biological sciences, 184 in 1999 (compared to 183 in 1996). Engineering, social sciences and physical sciences (which include physics, astronomy and chemistry) and psychology Doctorates made up the majority of the balance of the 687 Doctorates awarded. The following shifts over time within a relatively stagnant total (672 awards in 1996) suggest a migration toward information and environmental / behavioral fields: engineering down from 150 to 137; physical sciences down from 95 to 67; earth, atmospheric and ocean sciences up from 14 to 21, psychology up from 49 to 62; social sciences up from 117 to 134; mathematics up from 30 to 37; and computer sciences up from 23 to 35.



Science and engineering graduate student enrollment as a percentage of the young adult population is on par with competitor states; strong participation by African-American students.

Why measure it?

The graduate students of today represent the pipeline of tomorrow's practicing scientists and engineers.

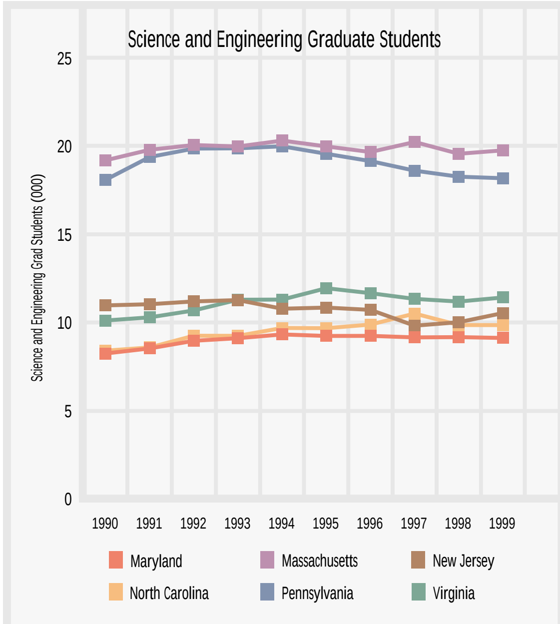
How is Maryland doing?

Maryland universities enrolled fewer science and engineering graduate students than any of the competitor states in 1999. The group was strongly split, with Massachusetts and Pennsylvania schools at twice the levels of the other four states; Maryland was at the bottom of the latter list. In addition to the 9,169 science and engineering graduate students enrolled at Maryland universities in 1999 who are included in this comparison, 3,777 Bachelor's degree candidates and 2,415 community college students were enrolled in science, engineering and technology courses. The state has made a commitment to double the number of information technology graduates by 2004, and the first-year results were ahead of targets.

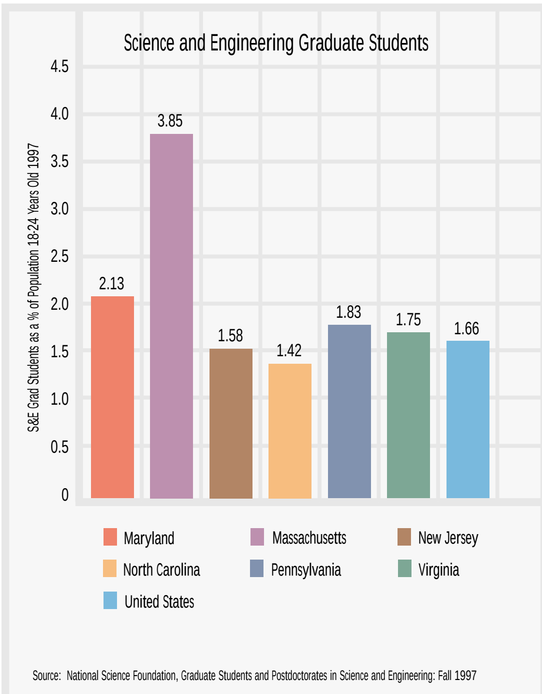
There has been little change in science and engineering graduate school enrollments among the competitor states in the last five years; small increases or decreases in one year have tended to be offset in following years. Pennsylvania is the exception, with a steady decline from a 1992 high. Nationally, science and engineering graduate enrollment has been falling since 1993. The stagnation of civilian federal research and development budgets and downward trend of defense research and development in the 1990s has played a strong role. Increases in the late 1990s federal R&D budgets may improve the situation in the future.

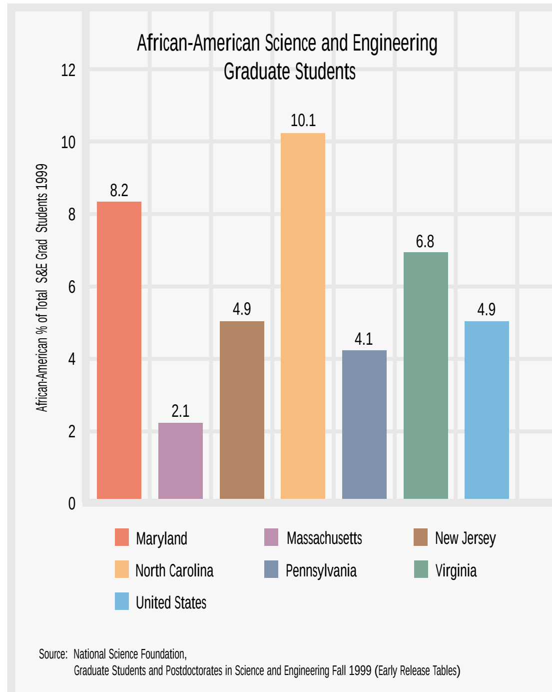
When normalized by the size of the population 18-24 years old, Maryland's science and engineering graduate student population ranked eighth in the country in 1997, and second to Massachusetts among the competitor states.

Maryland continued to be a leader in providing advanced educational opportunities to African-



Source: National Science Foundation, Graduate Students in Science and Engineering Fall 1999 (Early Release Tables)





Americans. Over eight percent of science and engineering graduate students in Maryland were African American in 1999, 67 percent higher than the national average, and second only to North Carolina among the competitor states.

Higher education performance in Maryland is highly rated except on affordability.

Why measure it?

The performance of higher education determines not only the quality of the workforce but also the quality of life in the state. Knowledge workers congregate in places where they and their families have opportunities for lifelong learning.

How is Maryland doing?

The National Center for Public Policy and Higher Education, a new nonprofit organization supported by a consortium of national foundations including The Pew Charitable Trusts and The Ford Foundation, has recently issued its first state-by-state report card on higher education. Preparation issues will be addressed in a later RESOURCES section on public schools.

In participation, Maryland ranked first among the competitor states (with a national index rating of 97) in adult (ages 25 to 44) enrollment in part-time postsecondary education in 2000. Along with Massachusetts, it also rated highly on the percentage of high school freshmen who enrolled in college within four years as well as the percentage of 18 to 24 year-olds who enrolled in college. New Jersey and Pennsylvania's young adults went to college at high rates, but there was low participation by working-age adults. Only a modest percentage of Virginia high school students went immediately to college, and North Carolina had low scores on all three measures of participation.

Since 82 percent of Maryland's college and university students attended public institutions, the relatively high (even in relation to the state's high income levels) costs of attending gave it a D in affordability. Massachusetts' overwhelming reliance on pricey private institutions gave it a similarly low score. New Jersey and Pennsylvania provided high levels of financial assistance for higher education to low-income families. North Carolina's public institutions, with available financial aid, were judged to be very affordable, as were Virginia's two-year schools but not its four-year colleges and universities. Neither of the latter two states made significant investment in assistance to low-income families.

All the states did well in retaining higher education students from freshman to sophomore year, and in seeing a high percentage of first-time, full-time college students earn Bachelor's degrees within five years. Maryland's relatively lower rating was the result of only a fair score on the proportion of students who completed certificates and degrees relative to the number enrolled.

The "benefits" index tends to measure the educational attainment of the population, which is detailed elsewhere in this *Index*. However, it also includes ratings from the National Adult Literacy Survey of 1992. Although dated, it provides useful comparisons of adult quantitative literacy, prose literacy and document literacy. Maryland ranked first among the states on all three measures, followed by Virginia, New Jersey, Massachusetts, Pennsylvania and North Carolina.

Higher Education Performance 2000

Measure	MD	MA	NJ	NC	PA	VA
Preparation	B+	A	A	B	C+	B
Participation	A	A-	B+	D	C	B-
Affordability	D	D	B	A	C	C
Completion	B-	A-	B-	B+	A	B
Benefits	A	A-	A	D+	B-	B+

Source: National Center for Public Policy and Higher Education

Measuring Up 2000: The State-By-Sate Report Card for Higher Education

SUMMARY
PERFORMANCE
DYNAMICS
RESOURCES
APPENDIX

Maryland public school students' scores are average on standardized tests.

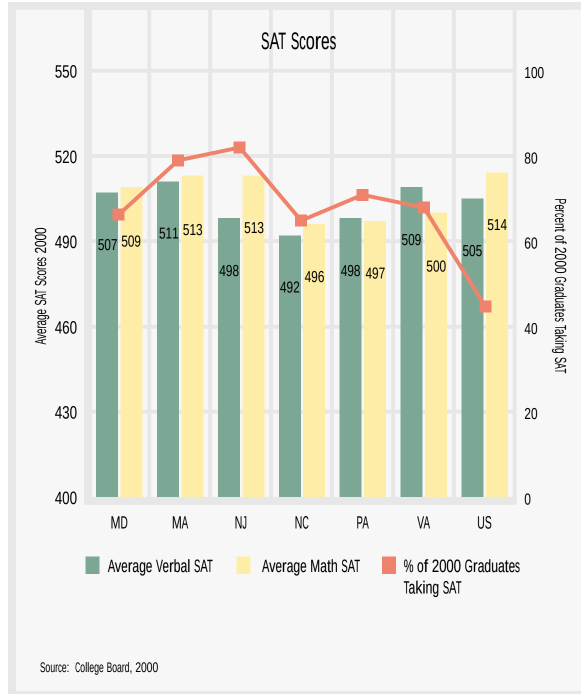
Why measure it?

The performance of public school students on national tests is important for two reasons. First, these students are most probably the state's technology workforce of the future. Their performance in middle and high school begins to circumscribe their postsecondary options, and therefore the skill levels with which they will emerge into the workforce. Second, the mobile skilled workers prized so highly by technology firms do not have to live in areas that do not have high-quality schools. No matter how imperfect these measures are judged to be, they are influential in the location decisions of desirable workers.

How is Maryland doing?

Despite high levels of income and education among parents, Maryland students appear to be performing at slightly below national average levels. Verbal SAT scores were two points higher than the national average, but math scores were five points lower in 2000. Fewer than two thirds of Maryland high school graduates took the SAT test, which was above average but behind leading states, and may suggest that a significant percentage of families were not aspiring to a place in the high technology future for their children.

In 2000, the National Center for Public Policy and Higher Education, a new nonprofit organization supported by a consortium of national foundations including The Pew Charitable Trusts and The Ford Foundation, issued its first state-by-state report card on higher education. A portion of its metrics focused on college preparation. Measures include: ninth to 12th graders taking at least one upper-level math or science course, eighth grade students taking algebra, eighth graders scoring at or above "proficient" on the national assessment exam in math, reading, or writing; number of



College Preparation
Index Scores (best state ranked 100)

Measure	MD	MA	NJ	NC	PA	VA
Math course taking	85	100	94	100	76	82
Science course taking	85	100	94	84	76	82
Algebra in eighth grade	85	118	94	96	75	82
Math proficiency	75	85	94	62	75	65
Reading proficiency	82	95	94	82	75	87
Writing proficiency	74	100	94	87	75	87
Math proficiency among low income	32	37	94	32	75	26
College entrance exams	80	94	85	56	65	70
Advanced placement exams	98	97	94	72	48	103

Source: National Center for Public Policy and Higher Education
Measuring Up 2000: The State-By-Sate Report Card for Higher Education

scores in the top 20 percent nationally on SAT / ACT exams per 1,000 high school students; and number of scores that are three or higher on an Advanced Placement subject test per 1,000 high school juniors and seniors. On most of these measures, Maryland was in the bottom half of the competitor states.

Workforce is concentrated in technology occupations, particularly biological sciences and computer-related professions.

Why measure it?

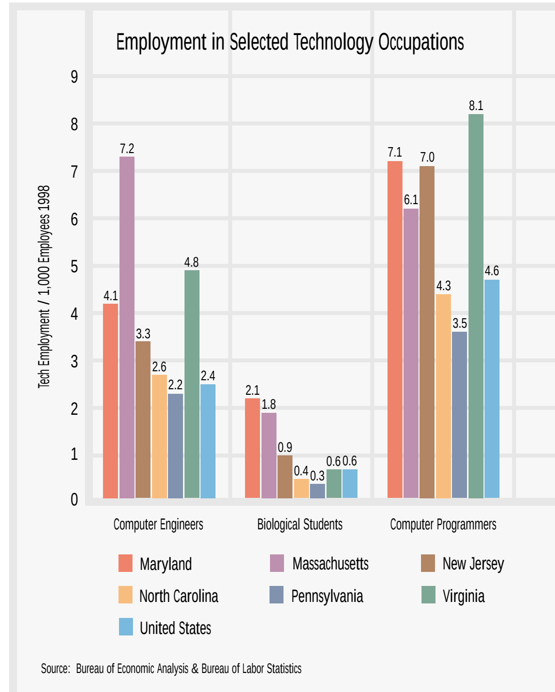
Skilled workers are technology industry's most critical resource. Technology-driven companies are dependent on their employees' conceptual ability, accumulated knowledge and experiential know-how for their competitive edge.

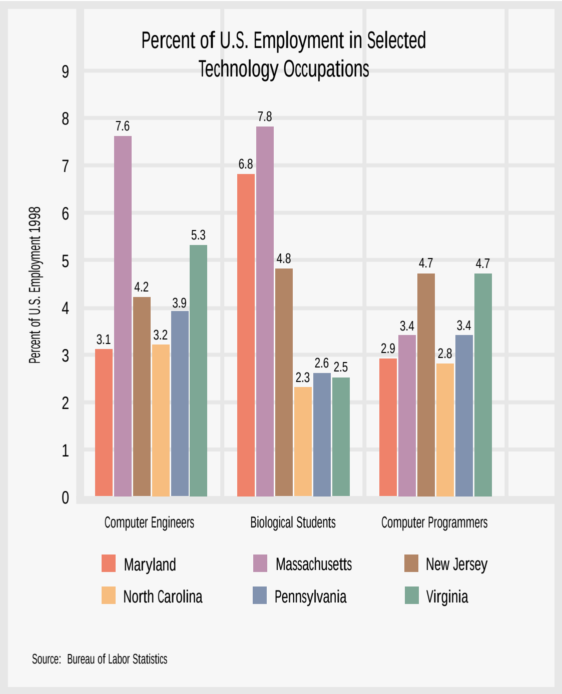
How is Maryland doing?

A larger percentage of Marylanders were employed in highly skilled occupations in 1998 than was the national average. Of the competitor states, Massachusetts, Virginia and Maryland led in the percentage of their workers who were computer engineers. Virginia, Maryland and New Jersey led in percentage of computer programmers. Maryland was the leader in percentage of biological scientists, though Massachusetts' biological scientists made up almost twice as large a share in 1998 as in 1996.

Computer engineers accounted for a larger percentage of Maryland's workforce in 1998 (4.1 percent) than in 1996 (2.8 percent), while biological scientists' share dropped from 2.6 percent to 2.1 percent. The computer programmers category cannot be compared to 1996 data because of a change in occupational definitions.

While Maryland made up only 1.78 percent of the total employment of the United States in 1998, 6.8 percent of the nation's biological scientists were working in Maryland, down from over nine percent in 1996. Over three (3.1) percent of U.S. computer engineers and 2.9 percent of U.S. systems analysts / computer programmers were Marylanders.




Percent of U.S. Employment in Selected Technology Occupations
Percent of U.S. Employment 1998
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4.7
2.8
3.4
4.7
Computer Engineers
Biological Students
Computer Programmers
Maryland
Massachusetts
New Jersey
North Carolina
Pennsylvania
Virginia
Source: Bureau of Labor Statistics

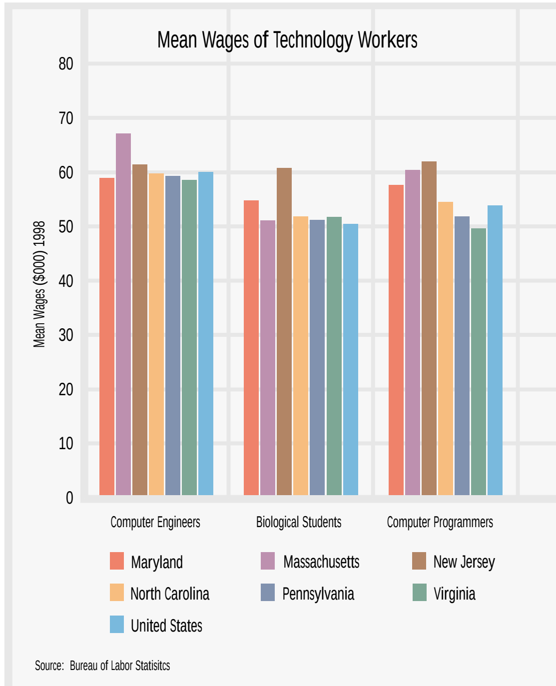
Wages earned in technology occupations are competitive with other leading technology states.

Why measure it?

Prevailing wages that are too low will not attract the most skilled workers, who are critical to the success of high technology industry. If wages are too high, technology employers may consider other locations for investment. Prosperity in Maryland depends on continued growth of quality employment opportunities.

How is Maryland doing?

Average wages for the selected technology occupations were in the middle of the range of the competitor states in 1998. Since 1996, mean wages for biological scientists and computer programmers grew faster than the national average and exceeded it in 1998 by nine percent and seven percent, respectively.



SUMMARY
PERFORMANCE
DYNAMICS
RESOURCES
APPENDIX

Maryland and surrounding states are home to one of the largest concentrations of venture capital under management in the country.

Why measure it?

Because venture capitalists provide not only funding but also management advice and contacts to the companies in which they invest, venture capitalists tend to invest within easy travelling distance from their offices. While some of the larger venture capital partnerships have opened up satellite offices, the location of these firms is a critical part of the infrastructure for commercialization of new technologies. According to the National Venture Capital Association, venture capitalists raised $10.7 billion in 1996, $15.4 billion in 1997, $27.2 billion in 1998, $51.2 billion in 1999, and $30.3 billion in the first half of 2000. Almost all of the money raised in the past year has been follow-on funds by established venture funds.

How is Maryland doing?

Maryland was the ninth-ranked state in venture capital under management in 1999, even before New Enterprise Associates raised its $1.2 billion fund in 2000. Over a dozen venture capital firms are located in Baltimore City and an equal number in the Baltimore and Washington, DC/Maryland suburbs. Local entrepreneurs have easy access to the capital raised by venture funds not only in Maryland, but also in other high-ranking nearby states and the District of Columbia: New York (ranked second), DC (sixth), New Jersey (eighth), Pennsylvania (10th), and Virginia (12th). Collectively, venture capitalists in these Mid-Atlantic states had $43 billion under management in 1999.

The Small Business Investment Company (SBIC) program created by the federal government in 1958 and refined in the 1990s to provide early stage funding to companies not ready for institutional venture capital. In SBIC funds disbursed between 1996 and 1998 per $1000 Gross State Product, Maryland ranked 38th in the U.S. and last among the competitor states. The launch of a new SBIC by the Maryland Technology Development Corporation in 2001 will raise these totals in future assessments.

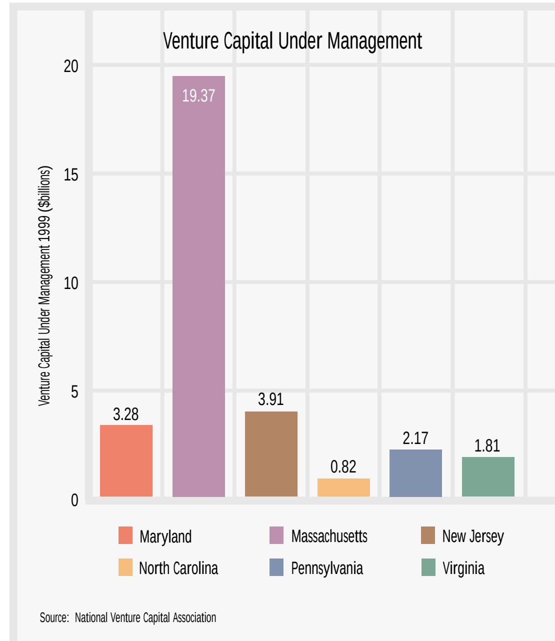


Table of Contents
Back
Forward

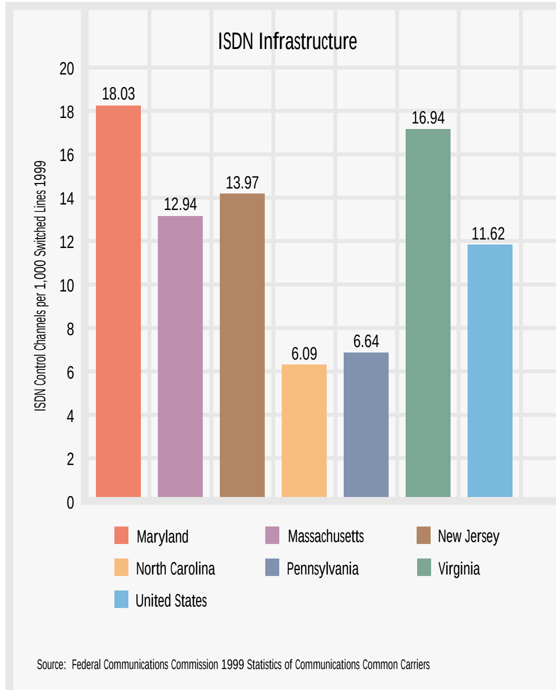
Telecommunications infrastructure meets requirements in high-technology companies.

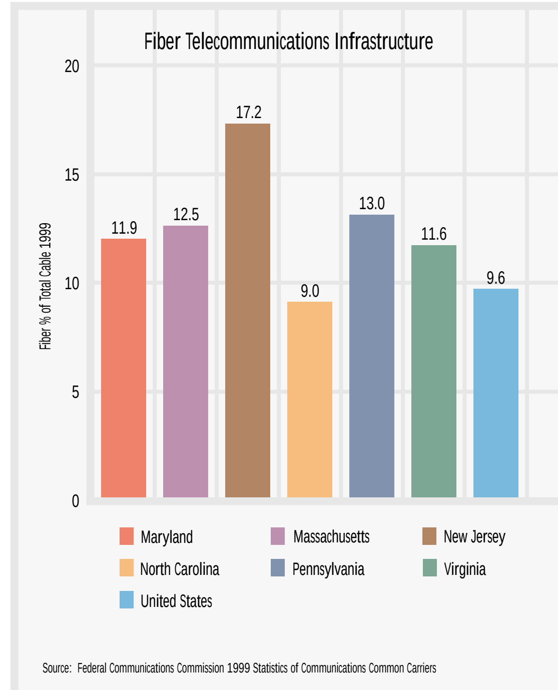
Why measure it?

As new computing, transmission and data-compression technologies permit global communication of voice, video and data virtually instantaneously, the quality of a state's communications infrastructure has become a key factor in the competitiveness of its companies.

How is Maryland doing?

In 1999, Maryland led the competitor states in deployment of ISDN (Integrated Services Digital Network), the digital technology that allows copper lines to carry both voice and data. ISDN, both the Basic Rate Interface type that provides two data channels and a signaling channel, and the Primary Rate Interface, which provides 23 data channels and a signaling channel, has helped to meet on an interim basis the increasing demand for high-bandwidth digital communications. In the long run, however, as the price of deploying fiber optic infrastructure continues to drop,





even local loop service is being upgraded to fiber, which has greater carrying capacity. In fiber deployment, Maryland exceeded the national average but was among the bottom half of the competitor states in 1999.

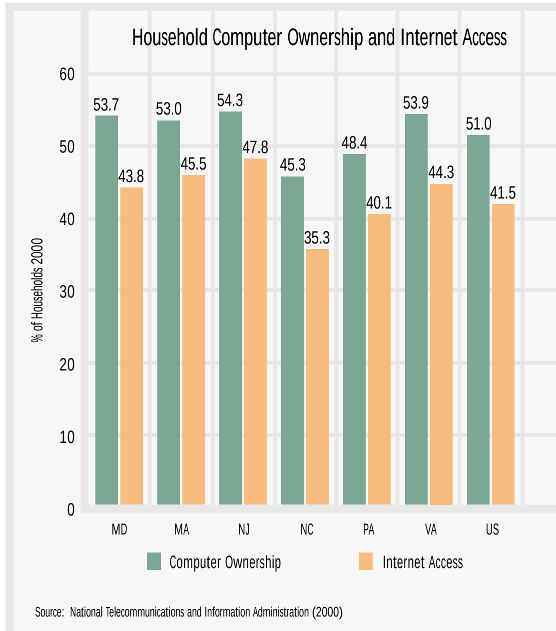
Computers in the home and household Internet access in Maryland are average among top-tier states.

Why measure it?

High rates of computer ownership and household Internet usage are indicators of an attractive market for information technology companies, and of a technology-savvy workforce, both now and in the future.

How is Maryland doing?

Despite having the highest median household income in the country, Maryland exceeded the national averages in computer ownership and household Internet access only slightly in 2000, and ranked in the middle of the six competitor states.



Maryland is ahead in school Internet access and digital government but lags in teacher participation and skills.

Why measure it?

There is considerable controversy about the role of computers in education, particularly of young children. A recent review of the research concludes that the effectiveness of education technology varies depending on a number of variables. Foremost among them is educator training. None can deny, however, that familiarity with computers and the Internet is increasingly essential to successfully navigating through life and work, and schools have the greatest capacity to deliver it to the largest percentage of the populace. The extent to which a state uses technology to improve the accessability and access of its own business with citizens sends a powerful signal to technology-based companies about quality of life.

How is Maryland doing?

As the result of a major effort by state and local governments, Maryland leads the competitor states (tied with North Carolina) in the percentage of its schools that had Internet access in 1999. A below-average percentage of teachers used electronic communications (e-mail), and had attained intermediate skill levels in using technology. The state government has similarly emphasized the migration to electronic communication of many state information and transactional services, and was ranked 12th nationally in a 1998 analysis by the Progress & Freedom Foundation, a think tank that studies the Digital Revolution and its implications for public policy.

Digital Schools and Government

Measure	MD	MA	NJ	NC	PA	VA	US
% of schools with Internet access 1999	95	88	90	95	87	94	90
% of schools where at least 50% of teachers have school-based e-mail addresses 1999	55	48	41	59	57	74	65
% of schools where the majority of teachers are at the intermediate technology-use skill level 1999	44	48	41	47	38	50	46
Utilization of digital technologies in state government 1998: National rank	12	14	28	33	10	17	

Sources: Education Week (1999) Technology Counts '99

Progress and Freedom Foundation (reported in Progressive Policy Institute, State New Economy Index, 1999)

Appendix

Sources & Notes

Indicator #1

Sources: Data: Office of Labor Market Analysis and Information (OLMAI), Maryland Department of Labor, Licensing and Regulation (2000). *Maryland High Technology 1999 Update.*

Text: U.S. Bureau of Labor Statistics (2000). Employment and Earnings, www.bls.gov

Text: U.S. Department of Commerce, Technology Administration (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Notes: Technology industries are defined by OLMAI and the U.S Bureau of Labor Statistics to include the following SIC codes:

Biotechnology and Biomedical

283 Medicinals and botanicals (pharmaceuticals)
384 Medical instruments and supplies
385 Ophthalmic goods

Information Technology and Services

357 Computer and office equipment
361 Electric distribution equipment
365 Audio and video equipment
366 Communications equipment
367 Electronic components
489 Communications services, not elsewhere classified
737 Computer and data-processing services

High-Technology Machinery and Instruments

351 Engines and turbines
353 Construction and related machinery
356 General industrial machinery
362 Electrical industrial apparatus
363 Household appliances
364 Electric lighting and wiring
369 Miscellaneous electrical equipment and supplies
382 Measuring and controlling devices
386 Photographic equipment and supplies

Defense and Aerospace

348 Ordnance and accessories, not elsewhere classified
372 Aircraft and parts
376 Guided missiles and space vehicles
381 Search and navigation equipment

Energy and Chemicals

131 Crude petroleum and natural gas
281 Industrial inorganic chemicals
282 Plastic materials and synthetics
286 Industrial organic chemicals
289 Miscellaneous chemical products
291 Petroleum refining

High-Tech Research

8711 Engineering services
8731 Commercial physical research
8732 Commercial nonphysical research organizations
8733 Noncommercial research organizations

Indicator #2

Source: U.S. Bureau of the Census (1998). *Annual Survey of Manufactures*, Geographic Area Statistics

North American Industry Classification System (NAICS) Manufacturing categories included:

3251 Basic chemicals manufacturing
3254 Pharmaceuticals and medicine manufacturing
3259 Other chemical products manufacturing
3332 Industrial machinery manufacturing
3341 Computer and peripheral equipment manufacturing
3342 Communications equipment manufacturing
3344 Semiconductor and other electronic component manufacturing
3345 Navigational, measuring, medical, and control instruments manufacturing

Indicator #3

Source: U.S. Bureau of the Census (1999). Custom data.

Indicator #4

Source: U.S. Bureau of the Census. *Census of Service Industries* (1987, 1992) and *1997 Economic Census*.

1997 North American Industrial Classification System (NAICS) services categories included:

54133	Engineering services
5415	Computer systems design and related services
5112	Software publishers
514191	Online information services
5142	Data processing services
5324209	Computer rental and leasing
811212	Computer and office machine repair and maintenance

Indicator #5

Sources: Cognetics, Inc. *Corporate Almanac* (1999) and *Entrepreneurial Hotspots* (2000).

Indicator #6

Source: U.S. Department of Commerce Technology Administration, (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Notes: Establishment births and deaths are employer-establishments added to or deleted from the records of the Standard Statistical Establishment List at the U.S. Census Bureau. Relocations, new name, ownership or address of a former establishment are not included.

Indicator #7

Sources: Data: Thomson Financial Securities Data (2000). Custom data.

Text: Corporation for Enterprise Development (2000). *Development Report Card for the States.*

Indicator #8

Source: Office of Labor Market Analysis and Information, Maryland Department of Labor, Licensing and Regulation (2000). *Maryland High Technology 1999 Update*.

Indicator #9

Source: U.S. Bureau of Economic Analysis.

Indicator #10

Sources: U.S. Patent and Trademark Office and U.S. Census Bureau.

Indicator #11

Source: Association of University Technology Managers (2000). *AUTM Licensing Survey: FY99.*

Notes: New patent applications filed in 1998 were estimated for universities that have not reported continuously for nine years.

Licensing income measure is adjusted gross licensing income beginning in 1998, subtracting payments to other institutions from gross licensing income, typically less than two to three percent of the total.

Indicator #12

Source: Data: National Science Foundation.

Text: National Science Foundation.

Indicator #13

Source: U.S. Small Business Administration.

Indicator #14

Source: U.S General Services Administration, Federal Procurement Data System. Custom data.

Indicator #15

Source: U.S. Small Business Administration.

Indicator #16

Source: Data: PricewaterhouseCoopers MoneyTree™ Survey.

Text: U.S. Department of Commerce Technology. Administration, (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Indicator #17

Source: National Institute of Standards and Technology.

Indicator #18

Source: U.S. Bureau of the Census (1998). *Annual Survey of Manufactures*, Geographic Area Statistics.

Indicator #19

Source: U.S. Bureau of the Census (1998). *Annual Survey of Manufactures*, Geographic Area Statistics.

Indicator #20

Source: U.S. Bureau of the Census. *Census of Service Industries* (1987, 1992) and *1997 Economic Census.*

Indicator #21

Source: Data: Corporation for Enterprise Development (2000). *Development Report Card for the States.*

Text: Cognetics, *Corporate Almanac.*

Text: U.S. Department of Commerce Technology Administration, (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Indicator #22
Sources: National Science Foundation, U.S. Bureau of Economic Analysis, U.S. Census Bureau.

Indicator #23
Source: National Science Foundation.

Indicator #24
Sources: National Science Foundation.
RAND Corporation (2000). *Discovery and Innovation: Federal Research and Development Activities in the Fifty States, District of Columbia and Puerto Rico.*

Indicator #25
Source: U.S. Bureau of the Census.

Indicator #26
Sources: Data: National Science Foundation.
Text: U.S. Department of Commerce Technology Administration, (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Indicator #27
Source: National Science Foundation.

Indicator #28
Sources: Data: National Science Foundation.
Text: Maryland Higher Education Commission.

Indicator #29
Source: National Center for Public Policy and Higher Education (2000). *Measuring Up 2000: The State-By-State Report Card for Higher Education.*
www.highereducation.org

Indicator #30
Sources: College Board and National Center for Public Policy and Higher Education (2000). *Measuring Up 2000: The State-By-State Report Card for Higher Education.*

Indicator #31
Source: U.S. Bureau of Labor Statistics.

Indicator #32
Source: U.S. Bureau of Labor Statistics.

Indicator #33
Source: Data: National Venture Capital Association
Text: U.S. Department of Commerce Technology Administration, (June 2000). *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.*

Indicator #34
Source: Federal Communications Commission.

Indicator #35
Source: National Telecommunications and Information Administration (2000). *Falling Through the Gap.*

Indicator #36
Sources: Education Week (1999). *Technology Counts '99* and Progressive Policy Institute (1999). *State New Economy Index.*